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THE ROENTGEN-RAY DIAGNOSIS OF LESIONS OF THE SMALL INTESTINE

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IN a recent article in the *Journal of the American Medical Association*[1] I called attention to the importance of the diagnosis of lesions of the small intestine. In this paper I wish to present more in detail the technique of the roentgen examination. Moreover we have by more intensive study encountered a larger number of cases in which we have been able to establish the diagnosis and secure operative confirmation. In my former paper I called attention to the paucity of the literature since the publication in 1922 of Mills' classic paper[2] on "Small Intestinal States." It is interesting to note that our special roentgen-ray technique has been developed by our roentgenologist, Dr. J. Leptich, a pupil of Dr. Mills.

Leptich's method is as follows:—

First: The patient must be examined in the upright posture.

Second: Begin to look for abnormalities in the small intestinal pattern from the 2½ to six hour period. They are very often encountered just about the time the last part of the barium meal leaves the stomach.

Third: Secure a film of the suspicious area at once and continue to watch for other overfilled loops, and plate at once. The shadows are apt to be evanescent. It is a mistake to expect them to be persistent. *Remember that you are searching for evidence of partial and not complete obstruction.*

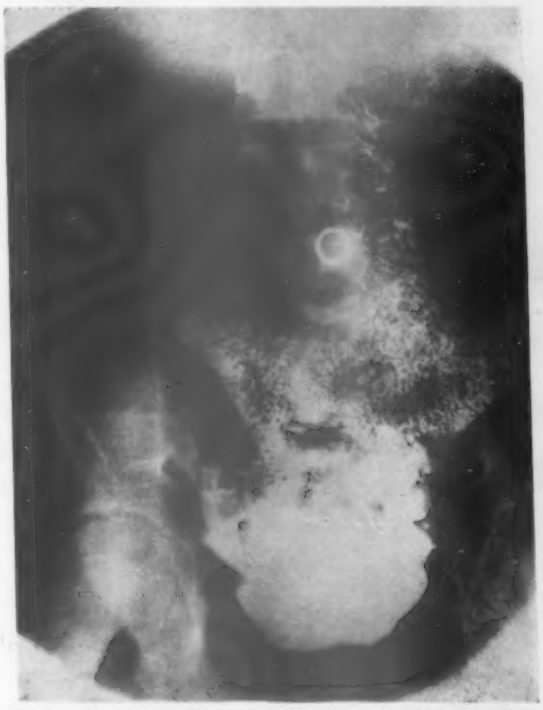

FIG. 1. Patient exhibiting asthenic type of habitus. The small intestinal pattern is of wide caliber and carried lower in the abdomen than in the other types. Tonus poor and motility slowest of any type. Normal patterns should be smooth and not irregular.

The shadows produced by peritoneal tuberculosis are bizarre and irregular in character and portray the various dilata-

[1] Soper, H. W. Carcinoma and other lesions of the small intestine. *J. Am. M. Ass.*, Jan. 26, 1929, xcii, 286–291.

[2] Mills, R. Walter. X-ray evidence of abdominal small intestinal states embodying an hypothesis of the transmission of gastro-intestinal tension. AM. J. ROENTGENOL., 1922, ix, 199–225.

Fig. 2. Patient exhibiting sthenic type of habitus. The small intestinal pattern is not so wide in caliber and is carried higher in the abdomen than the asthenic type.

Fig. 3. Patient exhibiting hypersthenic type of habitus. The small intestinal loops are seen much higher up in the abdomen, are small in caliber and exhibit a higher degree of tonus and more rapid motility than the other forms.

Fig. 4. Large ovarian cyst that dislocates the small intestine upward and to the right. Noted at five and a half hours. Atypical loops due to pressure effect.

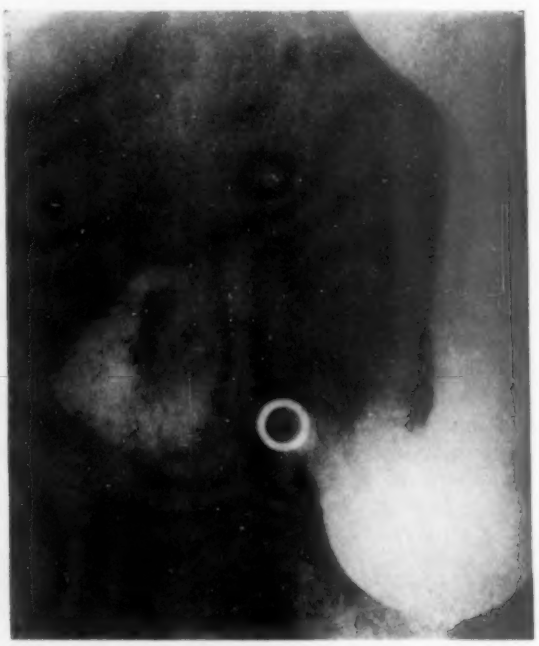

Fig. 5. Distortion of the first and second portion of the duodenum in a case of carcinoma at the head of the pancreas. At operation duodenum was found firmly adherent and fixed in this position.

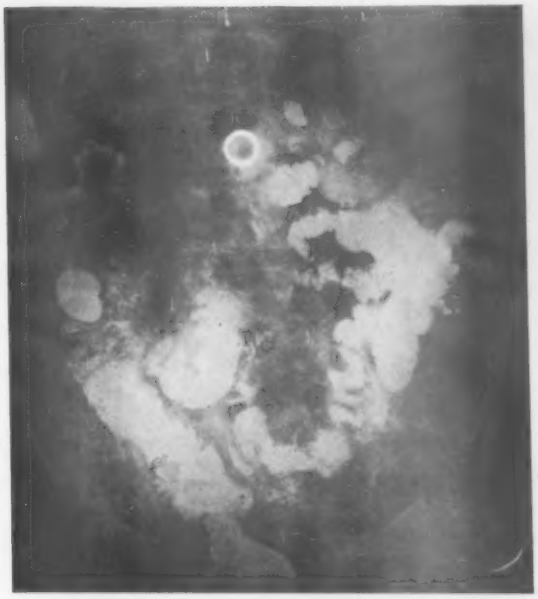

Fig. 6. Metastatic carcinoma of the abdomen. Note the irregular filling defects, dilatations and contractures.

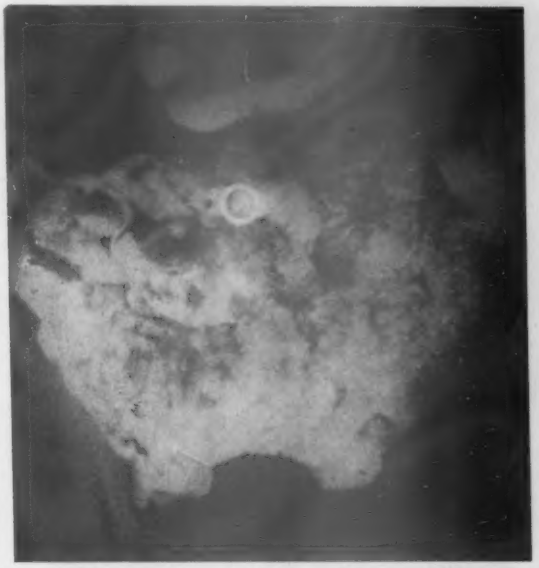

Fig. 7. Characteristic atypical small intestinal loops in a case of general intestinal and peritoneal tuberculosis. Note the irregular and scroll-like pattern of the loops.

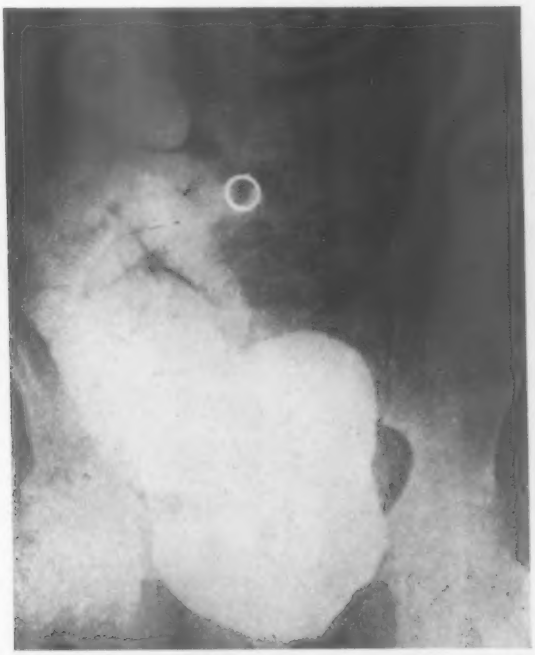

Fig. 8. A typical pattern following colectomy. This patient was operated on at the age of eight years. He is now twenty-three years of age and in perfect health. The colon was removed leaving the ileum attached to the rectum. The small intestine has enlarged and the ileum assumes the function of the colon.

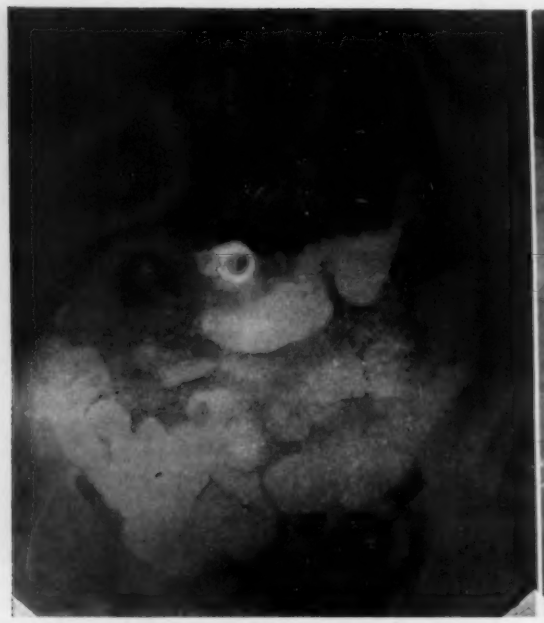

Fig. 9. Atypical pattern of the small intestine following colectomy and ileostomy for ulcerative colitis.

Fig. 10. Obstructive pyloric ulcer. Six hour film reveals a large amount of barium in the stomach. Small intestinal patterns are atypical in character showing small "bullets" of barium scattered throughout the intestine.

Fig. 11. Atypical pattern of the small intestine following appendectomy of the type that produces no symptoms. Five and a half hour observation.

Fig. 12. This type also illustrates atypical patterns that follow appendectomy, not to be regarded as pathological.

Fig. 13. Large pseudo-diverticulum located in the third portion of the duodenum, due to metastasis from a primary carcinoma of the colon.

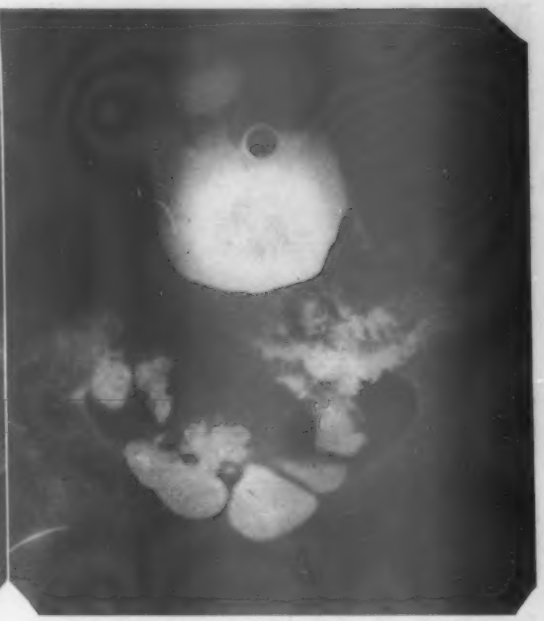

Fig. 14. Partial obstruction of the lower ileum due to inflamed Meckel's diverticulum. Patient was a chronic invalid of three years' standing, suffering from severe malnutrition. Note dilatation and sacculation on the six hour film. Good operative recovery.

Fig. 15. Same patient as in Figure 14, showing adhesions and dilatations about the terminal ileum in the twenty-four hour film.

Fig. 16. Intestinal adhesions following operation done two years ago. At five and a half hours Dr. Leptich observed roentgenoscopically an abnormal intestinal pattern in the iliac region. On continued observation he found a "puddling out" and abnormal pattern in the six and a half and seven hour films. Good operative recovery.

Fig. 17. Same patient as in Figure 16. Operation by Dr. J. W. Thompson disclosed the first adhesive band to be located at the brim of the pelvis. (The upper arrow points to a band adherent to the brim of the pelvis. The lower arrow points to dilated loop adherent to the pelvic colon.)

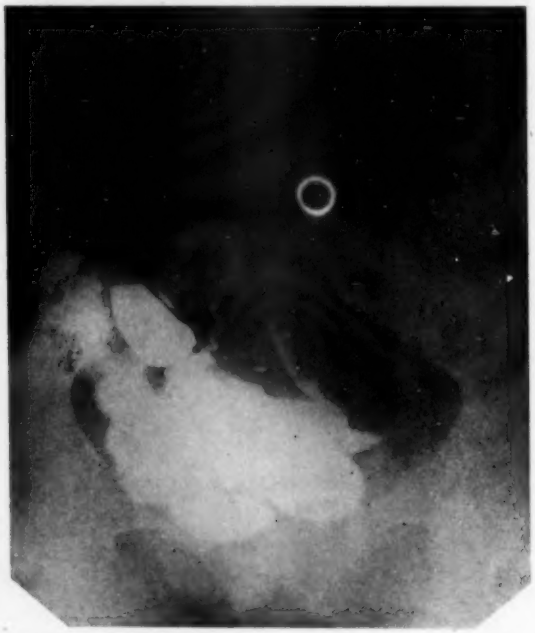

Fig. 18. Same patient as in Figure 16, showing a lower shadow which was found to be adherent to the right ovary.

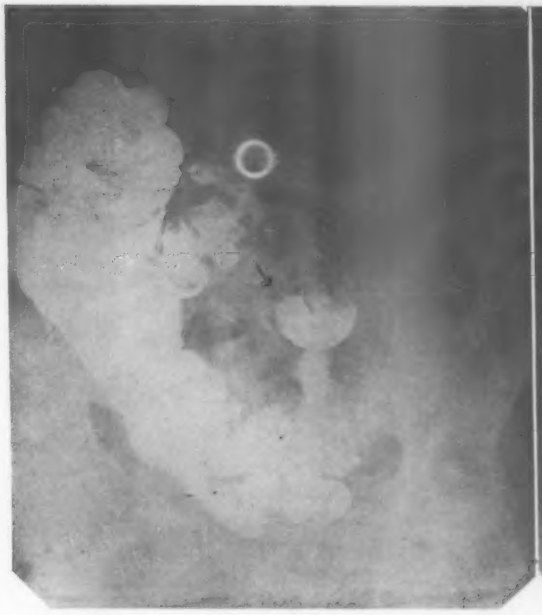

FIG. 19. Adhesive bands involving the lower ileum. The atypical loops were best seen at the five and a half hour observation. There was no twenty-four hour ileal stasis. Operation by Dr. J. W. Thompson disclosed an appendix acutely inflamed. It was adherent to the terminal ileum in such a way as to cause a kinking which resulted in partial obstruction of the bowel. The adhesions were freed and the remainder of the stomach and intestine found to be normal.

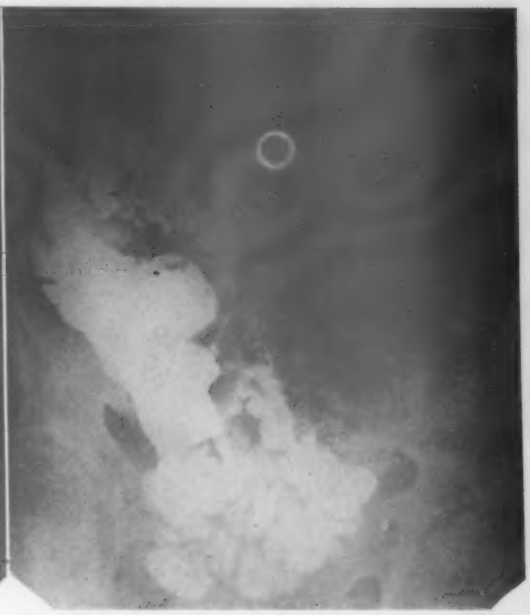

FIG. 20. Same patient as in Figure 19. Six weeks after operation. Normal intestinal loops. Patient made perfect recovery.

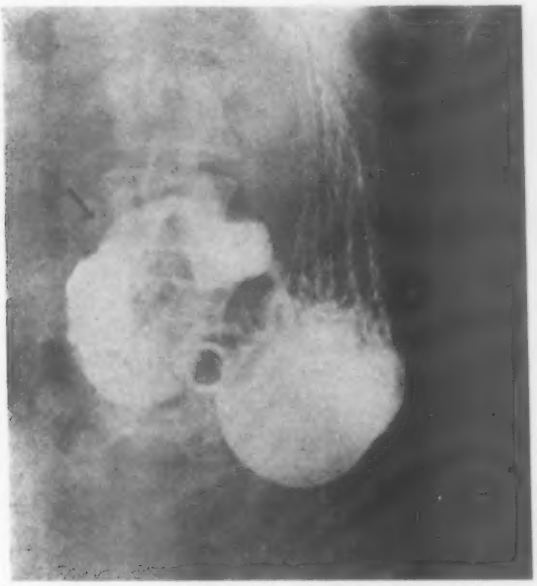

FIG. 21. Distortion of the first and second portions of the duodenum producing vomiting and general malnutrition. Two years ago the patient had an acute attack of encephalitis lethargica. Operation by Dr. Vernon Mastin disclosed adhesions about the duodenum. Small glandular masses scattered over the mesentery. Biopsy disclosed hyperplasia. Good operative recovery.

Fig. 22. Atypical loops observed on six hour film. Patient had suffered from attacks of partial intestinal obstruction. Operation by Dr. Vernon Mastin revealed a band about 3 feet from the ileocecal junction. Good operative recovery. (The lower arrow marks a narrowing corresponding to the exact location of the band.)

Fig. 23. Same patient as in Figure 22. Normal intestinal loops are here shown three months after the operation.

Fig. 24. Appendix operation two years ago. Colicky pains, nausea and vomiting attacks since. Roentgen examination showed atypical duodenal loops as barium was leaving stomach. The small intestinal loops were atypical in character. Roentgenoscopically the duodenal loop was found to be adherent to the abdominal wall. Good operative recovery.

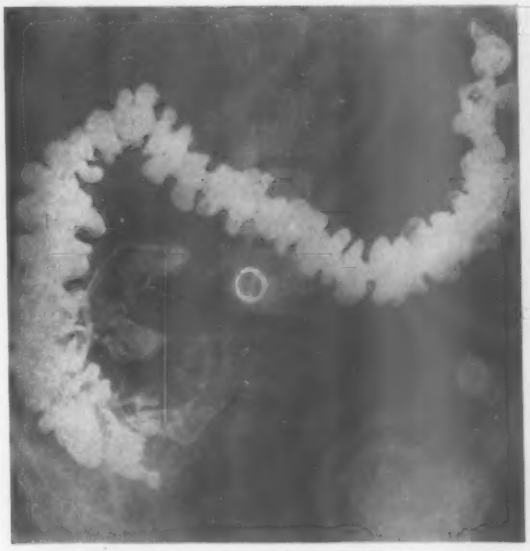

Fig. 25. Twenty-four hour ileal stasis. Young woman who had several attacks of partial obstruction. Operation was strongly advised but declined until an acute complete obstruction had occurred necessitating immediate surgery. Strong fibrous bands located in the ileum. Exitus.

Fig. 26. Distortion and dilatation of the third portion of the duodenum in gall-bladder adhesions. Differential diagnosis from malignancy was difficult. Feces negative for occult blood. Note that the gas bubble surmounts the "puddled out" barium.

Fig. 27. Atypical dilated loops showing general postoperative adhesions involving the small intestine. Seven hour film showed a "puddling" out in the dilated loops. This patient also presented a large residue in the ileum at the end of twenty-four hours.

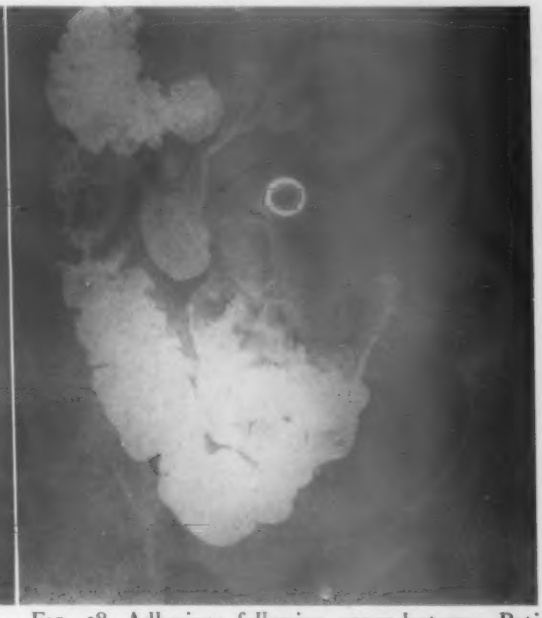

Fig. 28. Adhesions following appendectomy. Patient suffered from general digestive disturbances following the operation. The dilated loop reveals the site of the obstruction.

Fig. 29. Large pseudo-diverticulum in a case of carcinoma located at the juncture of the duodenum and jejunum. Note gas bubble. (Film taken by Dr. Oscar C. Zink at St. Luke's Hospital.)

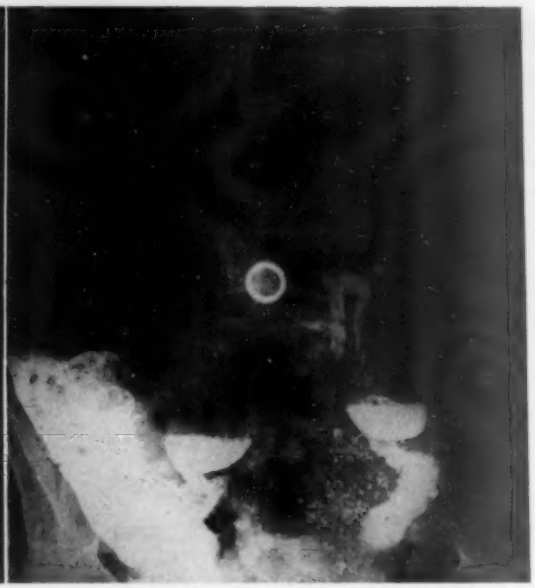

Fig. 30. Same case as Figure 29 depicting the shadow after the stomach had emptied.

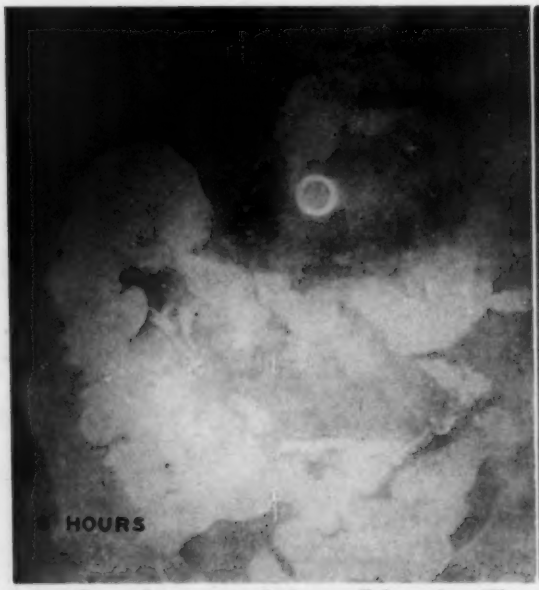

Fig. 31. Case of sarcoma of the small intestine. The differential diagnosis from diverticulum was made because of the strong persistent occult reaction and the presence of a palpable mass corresponding to the shadow. Operation by Dr. Vernon Mastin disclosed a sarcoma of the jejunum ulcerating into the lumen of the gut.

Fig. 32. Carcinoma of the small intestine. Gave a history of partial obstruction. Feces showed persistent strong occult blood reaction. The roentgen film showed atypical dilated intestinal loops. Was best seen at the five hour observation. Operative confirmation by Dr. M. B. Clopton.

FIG. 33. Carcinoma of the duodenum. The diagnosis was made solely on the persistence of the occult blood reaction. Gastrointestinal roentgen-ray series did not disclose evidence of lesions in the stomach, duodenum or colon. Operation by Dr. Elliott Dixon disclosed involvement of glands in mesentery making resection impossible. Biopsy revealed adenocarcinoma. One year later this film was secured showing evidence of the growth. Irregularity of second and third portion of the duodenum.

FIG. 34. Large duodenal diverticulum visualized immediately after barium meal. Producing no symptoms.

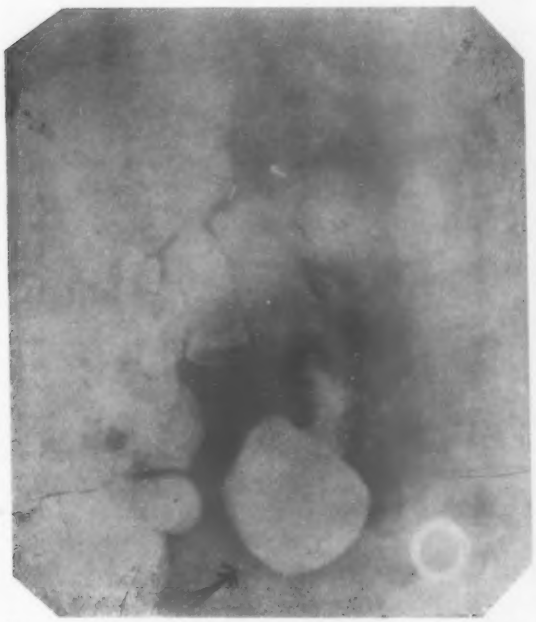

FIG. 35. Large duodenal diverticulum showing neck of sac

FIG. 36. Duodenal diverticulum in the third portion of the duodenum.

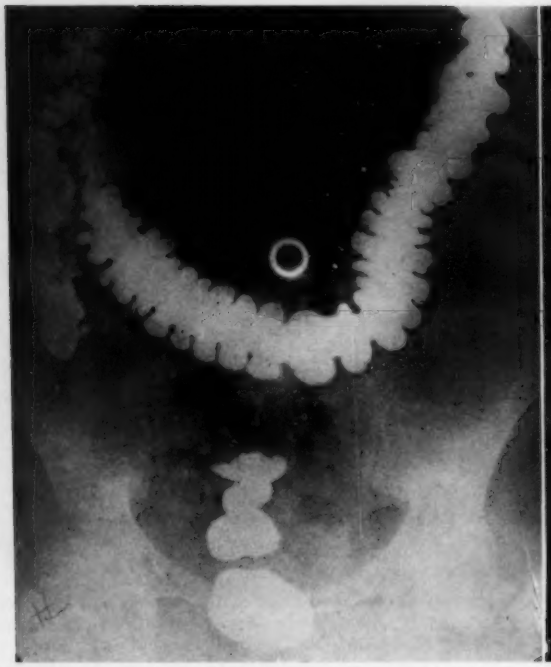

Fig. 37. Same patient as in Figure 36. Twenty-four hour film still shows retention of the barium in the duodenum thus excluding carcinoma. Note absence of gas bubble.

Fig. 38. Jejunal diverticulum producing no symptoms. The character of the shadow as presented on the roentgen films, its persistence and the absence of occult blood differentiated it from carcinoma.

Fig. 39. Diverticulum of the jejunum persisted on the twenty-four hour plate distinguishing it from carcinoma.

Fig. 40. Dilatation of the small intestine following obstructive carcinoma in the descending colon. Aggravated case of Mills' recoil phenomenon.

tions and contractures of the small intestinal loops scattered here and there. The shadows produced by abdominal metastatic carcinoma involving the peritoneum and small intestine are difficult to distinguish roentgenologically from tuberculosis. The localization of the primary growth is necessary to make the differential diagnosis.

Primary carcinoma of the small intestine may produce a pseudo-diverticulum the shadow of which may be impossible to differentiate from a true diverticulum. It is likely to be more irregular in character than the smooth outline of the simple diverticulum. Moreover, and this is a very important point, *the shadow of simple diverticulum persists a much longer time than that of carcinoma.* As I have emphasized, the occult blood reaction is rarely absent in carcinoma and is persistently absent in true diverticulum. Quite often the dilated loops of small intestine which are produced by carcinoma will show a gas bubble surmounting the barium level. I have never observed the presence of a gas bubble in true diverticulum.

The study of shadows produced by adhesions is very instructive and productive of results in diagnosis and treatment. Atypical patterns may be found in nearly all patients who have been subjected to abdominal section. They are more irregular in form than the smooth normal pattern. These atypical loops, while they indicate pathology, as a rule produce no symptoms.

Strong bands of adhesions may cause periodical attacks of partial obstruction of the small intestine. As a rule these bands produce partial temporary blocking of the bowel and show on the roentgen film as dilated loops. A gas bubble above the barium level is a frequent finding. Diagnosis is of extreme importance inasmuch as they are very amenable to operative treatment.

Twenty-four hour stasis in the ileum must be regarded as a pathological condition. Heed must be given to Case's warning that the nine hour film may show an empty ileum while a twenty-four hour observation may reveal barium in the terminal ileum because of regurgitation from the cecum. Of course it is obvious that barium may be present in the ileum twenty-four hours after a barium meal in case of pyloric obstructive lesions.

Extra-alimentary growths may produce distortion and displacement of the small intestinal loops by pressure, or the gut may become adherent to the tumor mass. I have purposely omitted detailed reference to the case histories. The legends under each film give all the information necessary for the establishment of the roentgen diagnosis.

CONCLUSIONS

Roentgenograms illustrating the roentgen diagnosis of the various lesions in the small intestine have been secured by intensive study of the course of the barium meal in its passage through the small intestine. A special simplified technique is presented which will enable the roentgenologist to add this fertile field to his diagnostic survey. It will enable the clinician to establish a preoperative diagnosis of small intestinal conditions and thus avoid the usual procedure of a surgical diagnosis in the stage of acute obstruction.

BRONCHIECTASIS

WHAT THE USE OF IODIZED OIL HAS DEMONSTRATED RELATIVE TO DIAGNOSIS BY ORDINARY ROENTGEN EXAMINATION*

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BRONCHIECTASIS has acquired a new interest for the roentgenologist since diagnostic bronchography with iodized oil has come into use. This method of examination makes possible the recognition of cases which formerly escaped detection by the ordinary roentgen examination and it has served to explain the nature of some doubtful roentgen findings so that the condition can be more readily diagnosed even without its use. As a result, many cases of suspected tuberculosis, asthma or chronic bronchitis are now recognized as belonging to this class, and the disease, instead of being a rare one, ranks next to tuberculosis as a chronic pulmonary affection. At the University of Illinois Medical School, 92 cases of bronchiectasis were investigated by both the ordinary and bronchographic methods of examination in about one and a half years and it is upon that study that this paper is based.

Before analyzing the roentgen findings of the cases studied, brief consideration will be given to the etiology and pathology of the disease for the purpose of indicating the class of patients usually affected and directing attention to the nature of the findings which the roentgen examination may be expected to disclose.

Bronchiectasis is an anatomic rather than a clinical entity and, as its name implies, it is characterized by a dilatation of the bronchi. It attains pathological significance when infection occurs within the dilated bronchi and their secretions and leads to a chronic productive cough and other symptoms. Some of the cases are undoubtedly of congenital origin, but most of them follow in the wake of the respiratory affections which accompany the diseases of infancy and childhood, especially the pneumonias. Others have their origin in conditions producing an atelectasis, notably aspirated foreign bodies. The occasional association with pulmonary tuberculosis, lung abscess and chronic paranasal sinusitis suggests an etiological relation in some cases. Years usually elapse between the time of inception of the disease and the time when the symptoms become sufficiently aggravated for the patient to seek medical aid.

The direct etiology is not known, but a number of theories regarding its pathogenesis have been advanced. The more plausible of them are: (1) Injury of the bronchial wall; (2) prolonged obstruction of a bronchus, and (3) sclerotic contraction of the parenchyma. No single theory explains all cases; in most of them a combination of factors is probably responsible for the changes produced.

As regards pathology, the dilatations may take the form of localized aneurysmal expansions called sacculations, or the lumen may be more or less uniformly enlarged. The latter variety to which the name cylindrical has been applied may exist merely as an increase in the caliber of the affected bronchi without other change, or the tubular expansion may be limited to parts of them. Frequently there are club-shaped enlargements or cul-de-sacs at the distal ends of the dilatations. When the condition is associated with atelectasis, lung abscess or tuberculosis, the dilatations are often atypical, though they clearly belong to the cylindrical class. The walls of the dilated bronchi may be attenuated, but as a rule they are thickened by inflammatory fibrosis. The lower lobes are affected far more frequently than the upper. The process may be unilateral or bilateral and may involve parts of a lobe, entire lobes or more or less of the entire lung. In addition to the pathology directly attributable to the bronchiectasis there may be residual or associated pathological

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

changes of the causative disease which tend to mask or complicate the picture presented.

Abnormalities of the bronchial wall plus a variable amount of air and secretion in the dilated bronchi produce the roentgen image associated with bronchiectasis. It is characterized by an increase of the linear markings with small irregular densities usually occurring in the lower lobes. In the advanced uncomplicated case there is a honeycomb appearance which is almost pathognomonic and which is familiar to all of us. This type of case is comparatively uncommon and of greater diagnostic than therapeutic interest because it is usually hopeless from the standpoint of treatment. Recognition of the earlier cases which may still be benefited by conservative therapy is particularly desirable and these present less obvious changes. It is intended to call attention to some of these in this paper.

The roentgen findings in our cases revealed by the injection of iodized oil were as follows: One case presented a pure saccular type of dilatation and two others showed a combination of these with tubular expansions. All of the others were of the cylindrical variety. Six showed what we called borderline changes: the dilatations were comparatively slight and the oil penetrated to the finer air passages. In 15, the dilatations were more marked and the injected oil stopped abruptly before reaching the distal ends of the bronchi. The rest of the cases had terminal enlargements or cul-de-sacs of various sizes and shapes. Dilatations associated with atelectasis or consolidations of the lung were often more or less atypical. The type found with tuberculosis presented a peculiar nodular and tortuous appearance suggesting gnarled branches of a tree. This finding was quite constant in the 6 cases of this nature subjected to the oil injection and it may have diagnostic value in the differentiation of doubtful tuberculous lesions.

A comparison of the roentgen findings before and after the injection of iodized oil demonstrated that cylindrical and saccular dilatations could not be differentiated by the ordinary examination. Suspected sacculations invariably proved to be cul-de-sacs associated with cylindrical dilatations. The findings on the plain films were grouped under the following heads: (1) increased linear markings; (2) irregular densities obscuring heart outline or dome of diaphragm; (3) irregular densities in the lower lobes; (4) displacement of heart shadow without demonstrable cause; (5) localized densities suggestive of atelectasis; (6) generalized densities with irregular radiolucent areas, and (7) honeycomb appearance. As regards hilus shadows with enlarged glands, it was found that little reliance could be attached to them in relation to the disease. They were enlarged in 30 of the cases. In some of these, the increase was bilateral although the bronchiectasis was unilateral.

Increase of the linear markings was by far the commonest finding, being present in 43 of the 92 cases examined. In 60 of these it was slight, in 14 moderate, in 16 pronounced and in 7 very marked. The degree of increase did not always coincide with the size and extent of the dilatations as shown on the bronchograms, but the certainty of diagnosis was directly proportional to it. The greatest difficulty was experienced in interpreting slight increases, and several cases were subjected to the oil injection which proved negative. The conception of what constitutes normal markings is largely a matter of individual experience and depends to a considerable extent upon the density of films one is accustomed to examine. A peribronchial fibrosis from some such cause as chronic or recurring bronchitis is hardly to be distinguished from that due to slight or early bronchiectasis except for the fact that it rarely has a predilection for the lower lobes. Twenty-one of the cases with increased linear markings also showed irregular densities.

As regards the irregular densities observed on the plain films, these were usually found to coincide with cul-de-sacs shown after oil injection. They probably represent variable amounts of air and secretion contained in them. Variations of the roentgen findings before and after profuse expectoration as previously noted by Moore and Marquis undoubtedly depend upon partial emptying of these dilatations. This also explains the fact that the dilata-

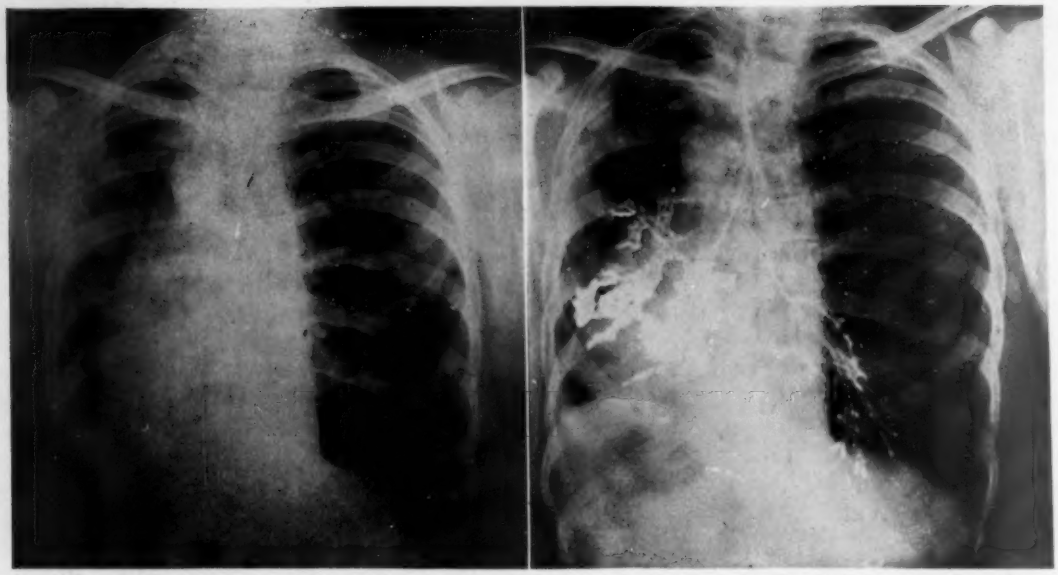

Fig. 1a. Case A. C. Female, aged forty-one. Cough and sputum since childhood. Exacerbations and remissions. Roentgen findings: Heart displaced towards left with border obscured.

Fig. 1b. After iodized oil injection. Bronchiectatic cavities behind heart. Diagnosis: Bronchiectasis left lower lobe.

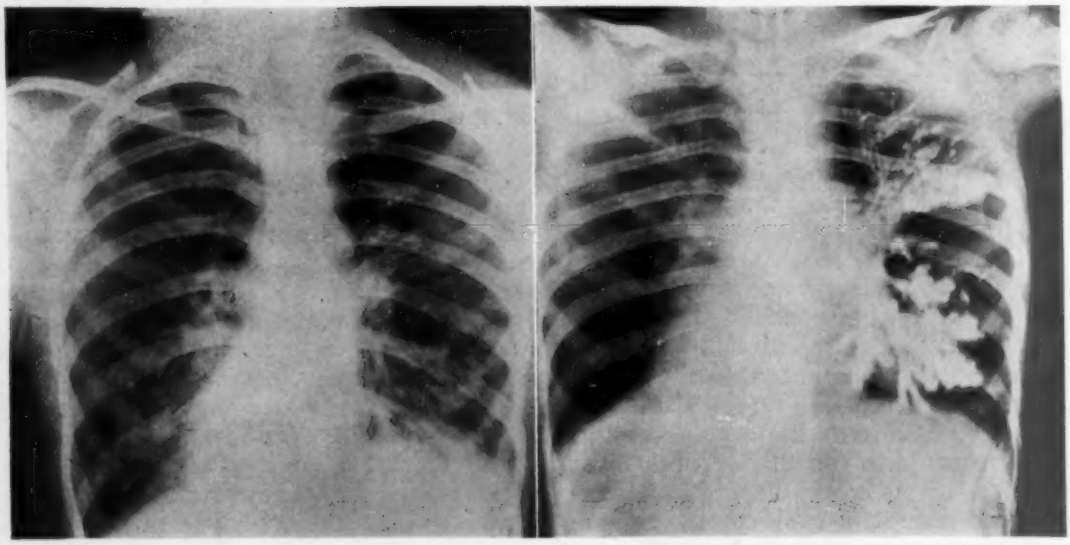

Fig. 2a. Case E. S. Female, aged ten. Cough and sputum 2 drams daily, five years' duration. History of pneumonia. Roentgen findings: Irregular densities in lower lobes, especially right.

Fig. 2b. After iodized oil injection. Tubular dilatations with cul-de-sacs. Diagnosis: Mixed type bronchiectasis right lower lobe.

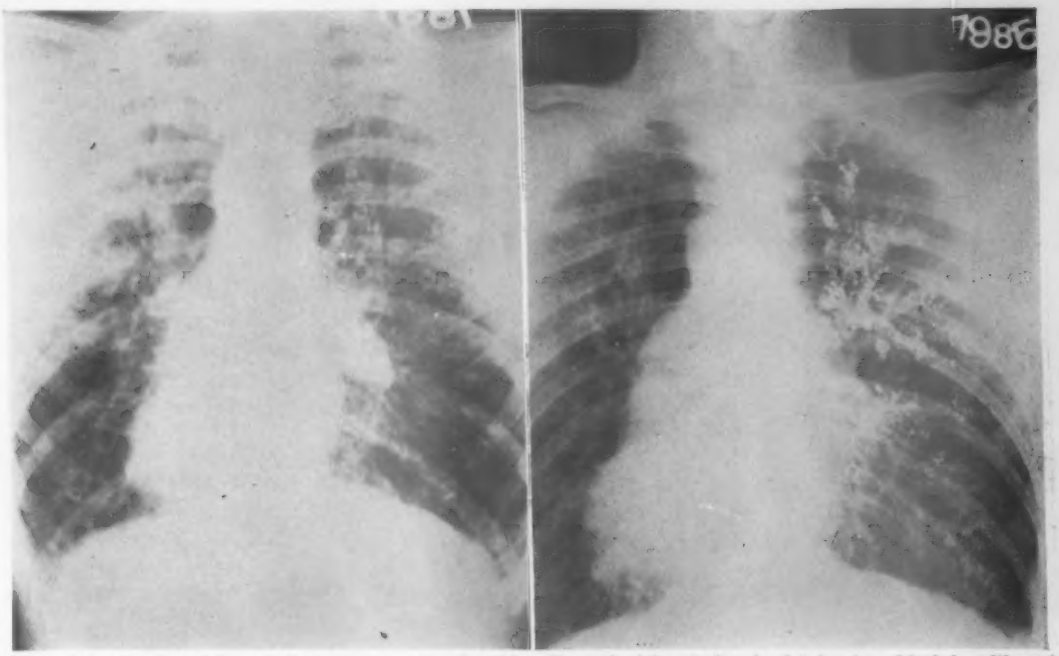

Fig. 3a. Case W. L. Male, aged forty-two. Cough and sputum 4–6 oz. daily, duration ten years. History of cold-pneumonia. Roentgen findings: Marked increase of right hilus shadow with localized densities. Irregular mottling of both lungs. Findings indicative of old hilus tuberculosis and productive parenchymal tuberculosis.

Fig. 3b. After iodized oil injection. Nodular dilatations of bronchi of right lung. Left lung subsequently injected showed same findings. Diagnosis: Nodular type of bronchiectasis.

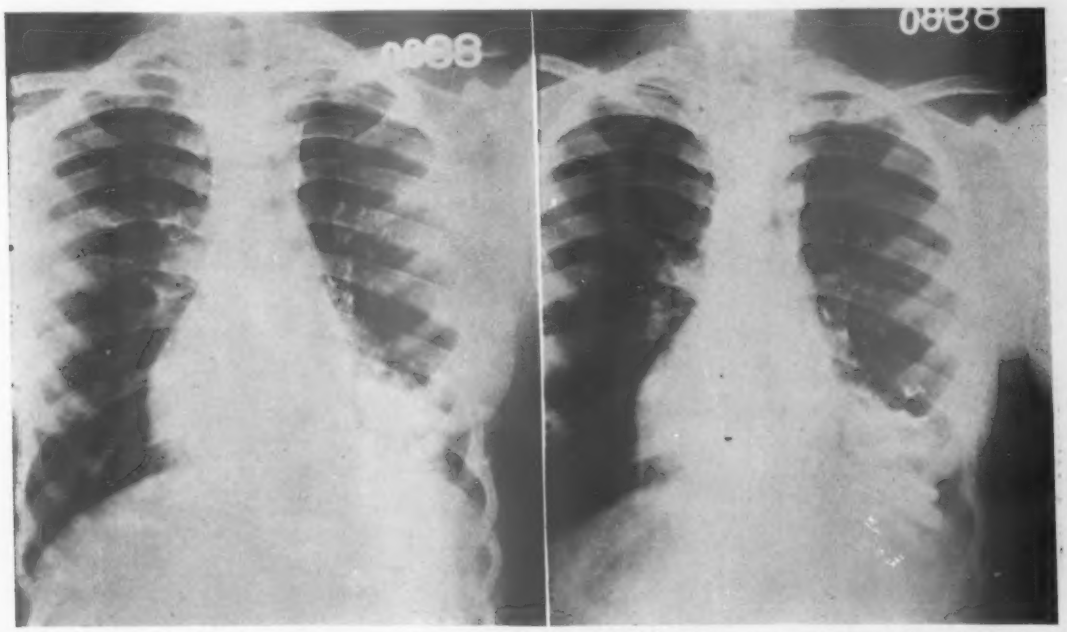

Fig. 4a. Case E. M. Female, aged fourteen. Cough and sputum six years' duration. Roentgen findings: Irregular density in cardiohepatic angle interpreted as partial atelectasis.

Fig. 4b. After iodized oil injection. Dilatation of bronchi in atelectatic area. Diagnosis: Bronchiectasis with atelectasis.

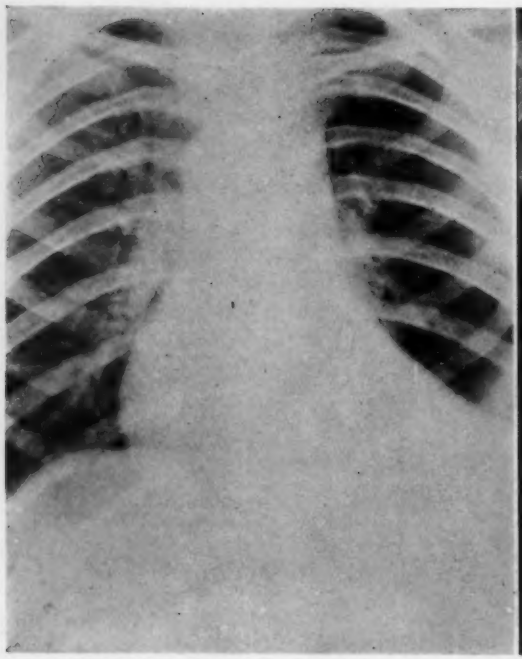

Fig. 5a. Case V. C. Female, aged eight. Cough and sputum of eight months' duration. History of cold and grippe. Roentgen findings: Uniform density in cardiohepatic angle extending from hilus to costophrenic angle. Interpreted as atelectasis right lower lobe.

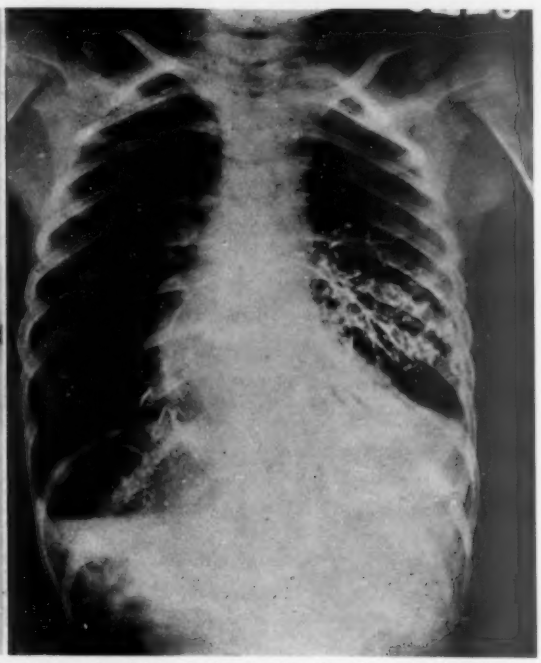

Fig. 5b. After iodized oil injection. Cylindrical dilatations of bronchi in atelectatic area. Diagnosis: Bronchiectasis with atelectasis.

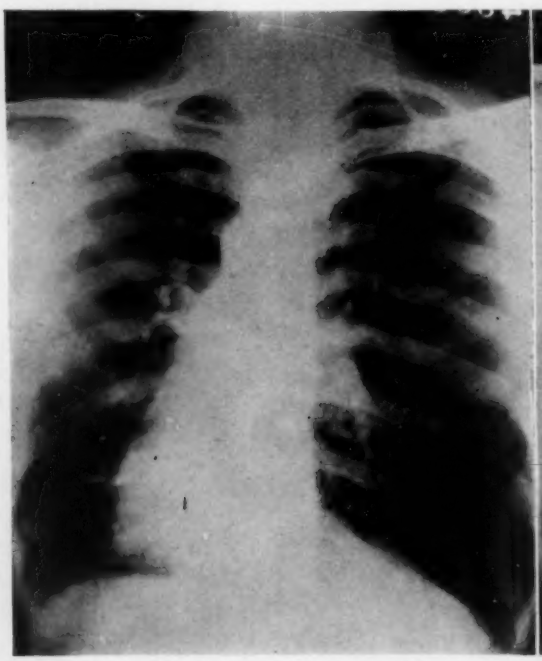

Fig. 6a. Case P. A. Male, aged forty-six. Cough and sputum ¼–½ cup daily, eight months' duration. History of influenza and frequent colds. Roentgen findings: Average amount of lung markings. Heart slightly displaced to left.

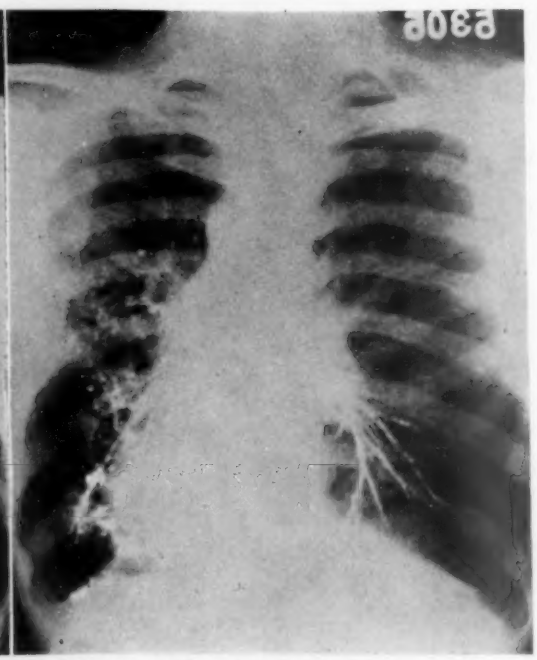

Fig. 6b. After iodized oil injection. Saccular dilatations of bronchi in left lower lobe, mainly behind heart. Diagnosis: Saccular bronchiectasis left lower lobe.

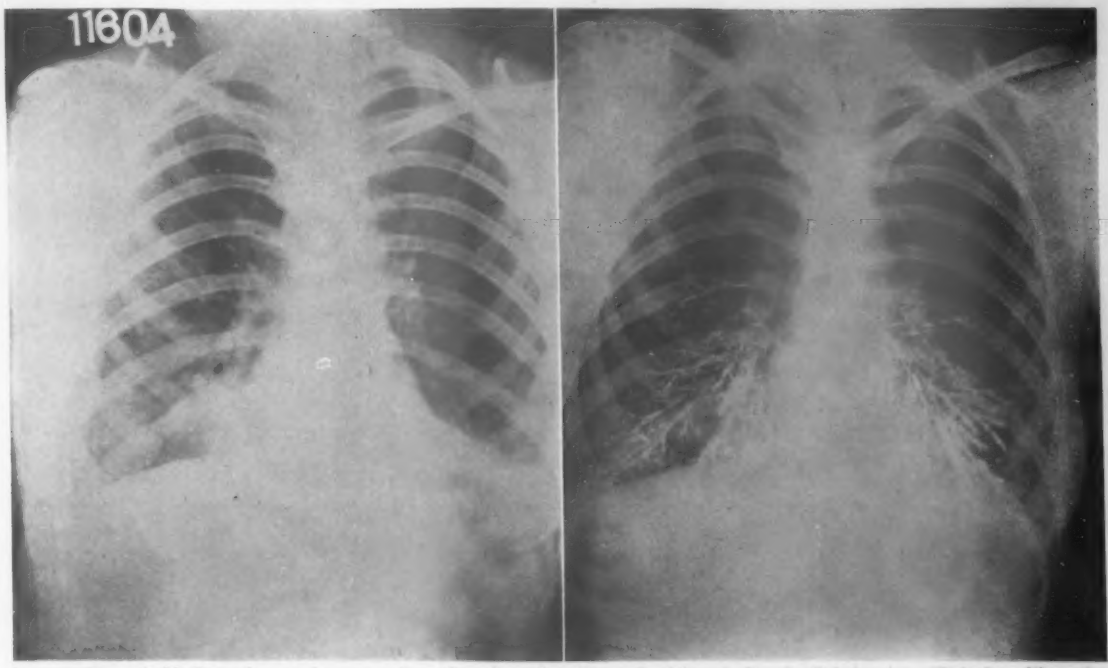

Fig. 7a. Case A. Y. Female, aged twenty-five. Cough and sputum—one cup daily. Roentgen findings: Hilus shadows increased. Irregular densities adjacent to heart shadow. Heart occupies median position. Left diaphragm high.

Fig. 7b. After iodized oil injection. Tubular dilatation of bronchi in both lower lobes, especially left, with cul-de-sacs. Diagnosis: Mixed type bronchiectasis lower lobes.

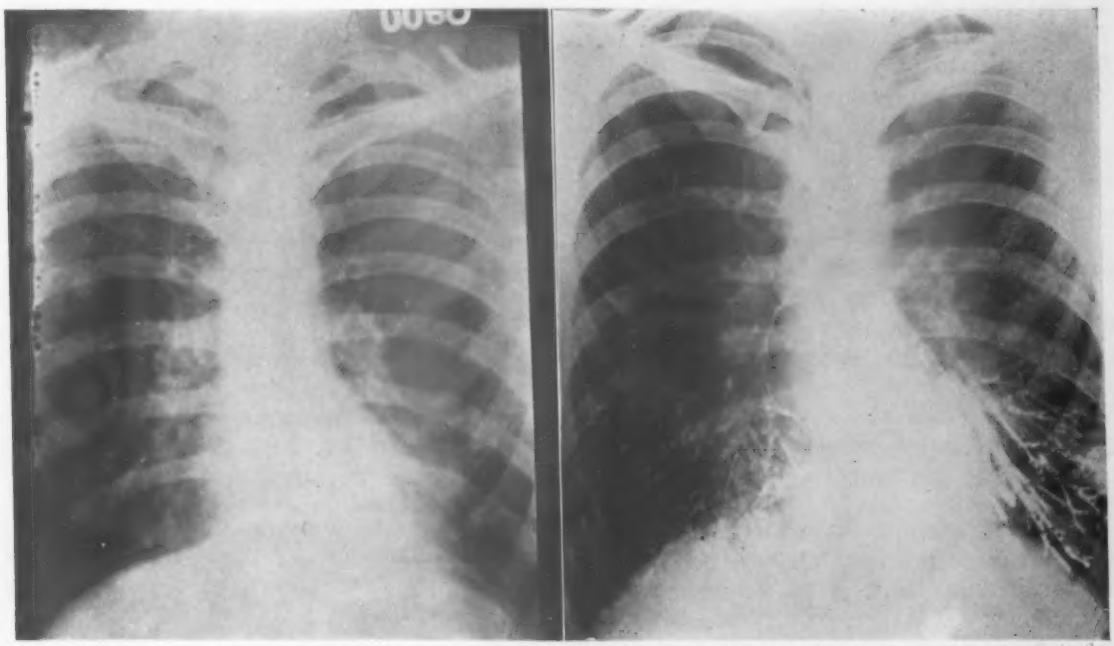

Fig. 8a. Case R. L. Male, aged thirty-three, cough and sputum, duration eight months. Cough productive from onset. Roentgen findings: Linear markings into lower lobes exaggerated. Heart outline obscured on left.

Fig. 8b. After iodized oil injection. Right lower lobe normal. Uniform dilatation of bronchi left lower lobe. Diagnosis: Cylindrical bronchiectasis left lower lobe.

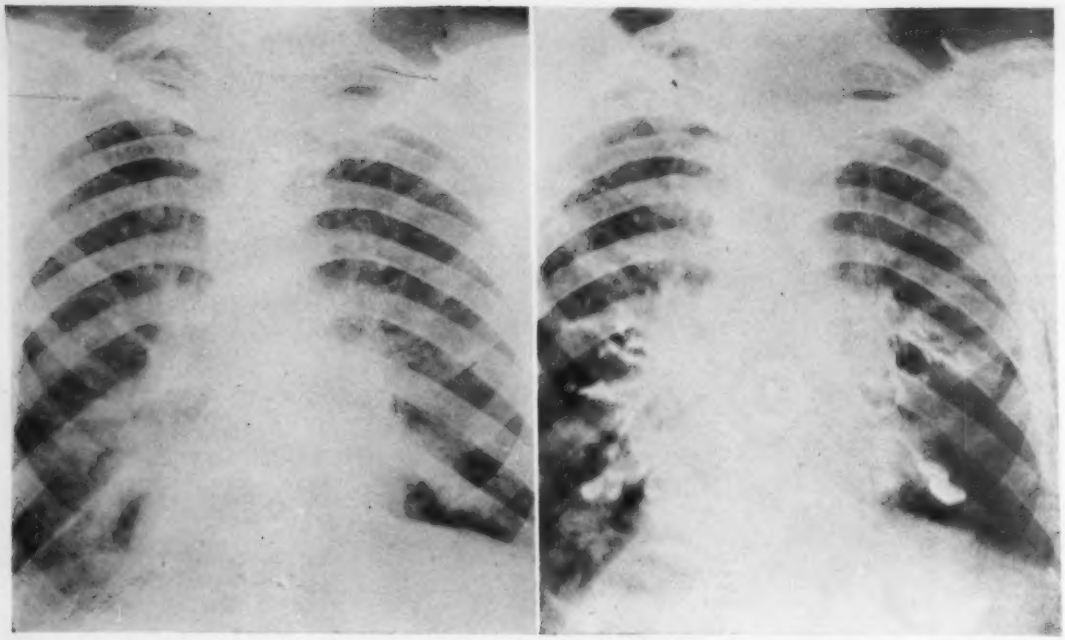

Fig. 9a. Case J. C. Male, aged thirty-seven, cough and sputum, duration twenty years. Roentgen findings: Irregular densities in lower lobes adjacent to heart shadow partially obscuring same.

Fig. 9b. After iodized oil injection. Tubular dilatations of bronchi with cul-de-sacs. Diagnosis: Mixed type bronchiectasis lower lobes.

tions seen on the bronchograms were very much greater in some cases than was indicated on the plain films.

Seven of our cases, which showed well marked dilatations on the bronchograms, showed practically none of the findings ordinarily associated with bronchiectasis on the plain films. The dilatations were behind the heart and obscured by its shadow. These cases did show displacement of the heart which was probably caused by sclerosis or atelectasis of the affected lung. This finding has led us to suspect the disease in all cases in which adequate explanation for abnormal heart location is lacking. Displacement of the heart towards the affected side was present in 27 other cases of our series but in these there were other signs pointing to the condition.

The most striking group of cases in our series was that in which atelectasis was probably the underlying cause of the bronchiectasis. The plain films on 4 of these cases showed sharply outlined, uniformly dense areas in the cardiohepatic angle which looked like encysted pleural effusions. In 3 others, the entire left lung was dense with irregular radiolucent areas and one showed similar findings in the left lower lobe. In all of these the heart was drawn towards the affected side. Injected oil showed cylindrical dilatations with cul-de-sacs in the dense areas. One other case, which came to autopsy and which was probably of congenital origin, showed atelectatic areas with bronchial dilatations in all of the lobes. In addition to the above, 11 cases showed findings suggesting atelectasis as a probable cause.

"Honeycomb" appearance, though probably the most characteristic finding of bronchiectasis, is mentioned last, because it is usually evidence of an advanced stage of the disease. It was present to a greater or lesser extent in 18 of our cases. Two marked instances of its involving most of the lungs, were found in tuberculous individuals and these showed typical nodular dilatations, previously described, on the bronchograms. In the others, cylindrical dilatations with cul-de-sacs were present.

Statistics based on the findings in the plain roentgenograms of cases in this series are as follows: In 92 cases in which this point could be determined, a correct

diagnosis both as to the presence and location of the lesion could be made in only 20 instances. In 17, the findings were suspicious. In 16 bilateral cases it was possible to make a positive diagnosis on one side while on the other, the findings were so slight or atypical, that no diagnosis, or merely one of "suspicious for bronchiectasis" could be made. In 39 cases it was impossible to make a diagnosis.

The reasons for the inability to make a correct diagnosis both as to the presence and location of the lesion were as follows:

No abnormal findings	11 cases
No abnormal findings on one side	12 cases
Lesions obscured by heart	17 cases
Lesions obscured by diaphragm	5 cases
Lesions obscured by fibrosis	21 cases
Lesions obscured by fluid in pleural cavity	1 case

Cases presenting findings similar to some of those which passed unrecognized at the time of making the examinations would undoubtedly be detected in the light of the knowledge acquired by this study. Its results seem to justify the following conclusions:

(1) In about 60 per cent of all cases a diagnosis of bronchiectasis can be made from a study of the plain films.

(2) In the majority of the remaining cases, such an examination will reveal findings of a nature to indicate the probable presence of bronchiectasis or the desirability for further investigation by bronchography.

(3) Diagnostic bronchography with iodized oil is absolutely essential for obtaining accurate information relative to the nature, location and extent of bronchiectatic dilatations.*

* The credit for instituting the investigation of the cases cited belongs to Dr. C. Hedblom and Dr. J. Head and I want to express my appreciation and thanks to them for permitting me to utilize their cases and work for the purpose of making this roentgen study.

EPIPHYSITIS OF ADOLESCENTS, WITH SPECIAL REFERENCE TO ETIOLOGY*†

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NO clear-cut scientific basis has yet been established which satisfactorily supports all the observations as to possible etiology which have been made in the group of lesions affecting the bony nuclei of growing epiphyses. Epiphyseal lesions of this type occupy an unusual position in that the clinical symptoms are of such a mild nature that operative treatment is rarely indicated and biopsies are infrequent. Autopsies seldom include an investigation of the epiphyses. Roentgen-ray examinations, almost without exception, are the most important means of definitely establishing the diagnosis and indicating the course of the condition.

Within the group under consideration are usually included adolescent coxa vara, or slipped epiphysis, a juxta-epiphyseal lesion, and osteochondritis of the vertebral body. Osteochondritis dissecans is considered by some to be of the same general type also, though usually occurring at a later age period. Luetic osteochondritis or epiphysitis, early and late rickets, typical endocrine epiphyseal changes, scurvy and typical infectious lesions of these parts are not primarily included in this discussion, although all of these except scurvy have been considered by various authors to be related etiologically to the so-called adolescent type.

Almost any growing epiphysis may be so affected, most frequently the capital epiphysis of the femur, the apophysis of the tibial tubercle and the tarsal scaphoid. Less frequently the second metarsal, the carpal semilunar, the os calcis or the olecranon epiphyses may be involved. More rarely, the head of the third or fourth metatarsal, the crest of the ilium, the nuclei or epiphyses of the vertebral bodies,

* Most of the observations herein discussed have been made in the laboratories of the roentgen department of the Indiana University Hospitals. Indebtedness to the other members of the staff for their cooperation is hereby acknowledged.

† Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

the head of the humerus, the trochanters of the femur, the patella or other parts may show changes.* It appears that it may involve almost any bone, but many observers have noted that such a disease is rarely found in any part which is not subject to direct or indirect trauma, muscular strain or static stress.

The theories advanced as to etiology are varied. Many believe the same cause or causes operate in all, the clinical and roentgen pictures differing on account of the different anatomical and mechanical factors present in the various parts. Others feel that the same pathological, clinical and roentgen appearances in the same anatomical area may be produced by rather widely different causes. Still others feel that changes are produced in one epiphysis by means quite different from those active in another. In spite of this lack of agreement, the preponderance of evidence and opinion favors the view that the same cause or causes, singly or in combination, are responsible for this type of epiphysitis in the various anatomical areas, with the probable exception of slipped epiphysis. In the present discussion, therefore, the group will be considered as a whole, citing the various theories as to etiology adduced for these lesions whether singly, in combination or as a group.

ETIOLOGY

The various causes operating here, as presented by various students of the subject may be grouped as follows:

1. Trauma.
   - External.
     - Single injury.
     - Repeated slight injuries.
   - Internal.
     - Muscular strain.
     - Static stress.
2. Alterations of blood supply.
   - Trauma.
   - Embolism.
3. Infection.
4. Abnormalities of bony development.
5. Constitutional conditions affecting bone.
   - Endocrine disturbances.
   - Late rickets.
6. Disturbances of innervation.

Trauma, in the sense of external injury, has held the attention of a great many as the primary, if not the sole, cause. It is contended that this may operate through either single or repeated slight injuries affecting the bone directly or indirectly by damaging the blood supply. Many of these observers hold that the bone is previously normal, although Axhausen argues from his experimental work and studies on Legg-Perthes' disease and Köhler's disease of the metatarsus that the fractures found here are pathological, involving necrosed bone. The not infrequent occurrence of Legg-Perthes' disease after reduction of congenital dislocation of the hip has been repeatedly mentioned as an argument for the theory of traumatic causation of this disease, the tissues of the epiphysis being considered to be more readily susceptible to injury on account of previous freedom from weight-bearing. Bentzon supports his theory of the traumatic etiology of Legg-Perthes' disease by experimental work in which he damaged the nutrient vessels of the epiphysis of the femoral head by injecting alcohol, some of the subsequent histological examinations showing pictures similar to those found in the few human cases of this disease studied microscopically. Bentzon believes that a bruise or strain may damage the vasomotor nerves of the adventitia of the blood vessels sufficiently to produce hyperemia of the epiphysis, this resulting in undue proliferation of cartilage and subsequent compression fractures. Nussbaum, however, failed to substantiate the traumatic theory of Legg-Perthes' disease after experimentally traumatizing the hip in dogs. He maintains that the process results from ischemia, an infection blocking the blood vessels and proliferation of cartilage occurring because this tissue derives ample nourishment from synovial fluid, while the bony tissue dies because it needs actual blood supply.

It must be admitted that some history of injury can usually be elicited in these cases, although the value and importance of such a history are ordinarily diminished by the trivial nature of the injury. The proponents of this theory point to the greater frequency of the occurrence of coxa plana, tibial apophysitis and tarsal scaphoiditis in boys, where exposure to injury would certainly seem to be greater than in girls, and to the usual location

* We place epiphysitis of the vertebral body among the less common forms since, in marked contrast to the findings of Buchman, we have found very few instances of this in reviewing our roentgenograms of various orthopedic conditions.

of the lesions in weight-bearing parts. The opponents of this view obtain support by pointing to the frequent bilaterality of the lesions in the above conditions, the absence of the usual histological changes found in simple fracture and the elevation of temperature shown by many of these patients, especially those with osteochondritis deformans coxae.

Alterations of blood supply have been recognized in these conditions by various observers but there is considerable difference of opinion as to what produces the altered circulation. The effects of injury have just been considered. Axhausen has suggested that the end vessels may be blocked by embolus. He believes that a primary aseptic necrosis of the epiphyseal bone occurs, followed secondarily by fracture, maintaining that the process is the same in at least osteochondritis dissecans, Legg-Perthes' disease, Kienböch's disease, tarsal scaphoiditis and Köhler's disease of the metatarsus. Nussbaum in studying Legg-Perthes' disease produced changes identical with those found in man, by sectioning the vessels of the femoral head in the young dog, the spongiosa of the epiphysis being completely necrotic while the cartilage of the joint and the epiphyseal line remained alive. He believes, however, that the disturbance of circulation is more probably produced by infection than by trauma and by a slow spreading of the process rather than by embolic blocking of the end vessels.

The theory of infection has appeared more frequently than any other in the various discussions. [2,4,5,9,11,14,17] Clinically, these bone disturbances have often occurred after diseases of known infectious nature. The symptoms frequently simulate a mild infectious condition including a slight elevation of temperature in many patients, especially in Legg-Perthes' disease, and the lesions may at times affect many areas as would a blood-stream infection. Except in parts subjected to considerable static strain, as in the vertebral bodies and the femoral head and neck, the tendency is toward complete restitution and ultimately normal development such as may be seen in the milder forms of osteomyelitis.

There has been little laboratory evidence to prove the presence of infection, however, in either histological or bacteriological examinations. Microscopical studies have not been numerous and the various investigators have disagreed as to the significance of the findings. Kidner, who formerly contended for infection as a causative factor in Legg-Perthes' disease, has more recently said that he thinks he shall have to abandon this theory after making microscopical studies on 4 cases, in spite of finding a real inflammatory reaction in all. In answer to these negative culture findings, it has been argued that the infection has been mild and easily overcome so that only the pathological changes have remained for study, although various students in this group are of the definite opinion that similar epiphyseal changes may also arise from other causes as well, such as trauma, congenital abnormalities of epiphyseal tissue and endocrine disturbances.

Tuberculosis and lues have also been accused but there seems to be very little basis for considering either seriously.

A number have argued that defective bony tissue is the etiological factor, while Schroeder feels that it is due to an anomaly of bone development, but these writers appear to be in the minority.

Considerable support is given to the importance of constitutional conditions affecting bone growth and development. Of these, endocrine disturbances have been perhaps most frequently mentioned, rather vaguely for the most part, though the thyroid has been specifically accused. Wilson investigated the basal metabolic rates of patients with adolescent coxa vara and found them normal. There is undoubtedly a group in which some ductless gland dysfunction plays a large part. Cretinism is especially likely to be the cause of abnormalities of epiphyseal ossification.[20] Infantilism of the genitals is frequently associated with slipped epiphysis of the femur in adolescents. However, it is to be expected that the other epiphyses would show some uniformity in alteration of growth and fusion if such a general factor were involved in the ordinary case and this has not been substantiated, even in patients of rather definitely endocrine type.

Rickets, necessarily of the late type in the majority of cases, has been considered an important factor[6] though the usual absence of multiple involvement has apparently been ignored by those taking this viewpoint, as has also the fact that very commonly the patients under consideration are of the robust type. Furthermore there seems to be no relation to dietary deficiencies, renal abnormalities or disturbed blood chemistry. Interference with neurotrophic supply has been considered important by some and an occasional case does seem to bear out this theory. On the whole, however, it scarcely seems to be of major importance in etiology. Riedel has interpreted the underlying process as due to osteitis fibrosa, a theory which has been refuted by others.

PATHOLOGY

Axhausen has perhaps done more than any other one worker to indicate the pathological course followed by these conditions. By experimental and histological studies he has shown that the bone changes are initiated by interruption of epiphyseal nutrition by some means, after which the epiphysis undergoes necrosis. This is followed by pathological fractures of the necrosed bone. At a later stage the necrotic bone is replaced. He feels that this is the process, at least in Köhler's disease of the metatarsus, and probably also in Legg-Perthes' disease, osteochondritis dissecans and Kienböch's disease. This is borne out in its essentials by the work of Nussbaum. The articular cartilage remains alive, probably being nourished through the synoviae. The adjoining portion of the metaphysis shows periosteal thickening and irregular changes in ossification in many cases, particularly in Legg-Perthes' disease, difficult to explain on the single basis of mechanical alteration of blood supply.

Changes in the adjoining articular surface may be present but are not frequent except in disease of the metatarsus and are probably due to changes of adaptation and secondary arthritis.

The roentgenological appearance in the early stages is normal, no alterations being found until after the process is well under way and the secondary changes of compression and fragmentation, periosteal thickening and cartilage proliferation are present. The joint space is preserved or increased, since the joint cartilage is not destroyed and may be thickened. The radiolucent areas mark new-formed cartilage. The epiphyseal line is irregular. Areas of condensation are present in the bony epiphysis, due to actual compression of the necrotic bone. Bone detail in the involved area is markedly disturbed. The affected portion is compressed and distorted by superincumbent body weight as the bony structure disappears, but except in the vertebra, hip and metatarsus there is a remarkably strong tendency to restitution of normal contour and structure. This period of healing is prolonged in many instances, notably in Legg-Perthes' disease, where the typical course extends over a period of eighteen months to four years or longer. The frequent appearance of osteoarthritic changes later in life has caused much discussion as to whether the arthritis is a direct continuation of the original lesion or is a result of altered bone and joint relations. At present there is disagreement upon this point.

A considerable number of cases of this type come under our observation. In some of them the association with infection has seemed to be more than a coincidence and worthy of particular note.

CASE REPORTS

Case I. J. H., white male, aged four, entered the out-patient department of the Riley Hospital on July 7, 1928, because of slight discomfort in the left hip which had been present for about twelve months. The previous history was otherwise irrelevant and no abnormal physical findings were recorded.

Roentgen examination of the pelvis gave evidence of typical osteochondritis deformans juvenilis (Fig. 1). Study of the other epiphyses showed a similar change in the capitellum epiphysis of the left humerus (Figs. 2 and 3).

Case II. B. D., white male, aged fourteen, entered the Long Hospital, Sept. 26, 1925, on account of pain and swelling over the left tibial tuberosity. A nail had penetrated deeply into this area the previous July. Within forty-eight hours acute local symptoms of infection had occurred, necessitating incision and drainage. After apparently complete recovery, a direct bruise over this region was received on Sept. 10, 1925, which was followed by acute pain and fever. Considerable pus was

found upon incising the part on Sept. 27, 1925, and the bone was found to be involved. Healing was very slow but full recovery had occurred by March, 1926.

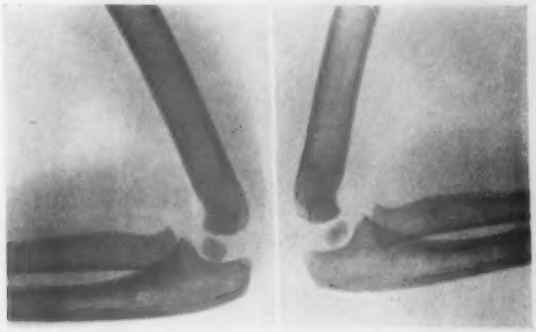
Fig. 1. Case 1. Legg-Perthes' disease in the left hip.

Roentgen examination, Sept. 26, closely simulated the appearance of Osgood-Schlatter's disease (Fig. 4). Bone healing appeared to be complete at the examination of Nov. 9, 1925.

A B

Fig. 2. Case 1. A. Normal right elbow, anteroposterior view. B. Left elbow, anteroposterior view. Symptomless osteochondritis in patient with Legg-Perthes' disease.

Case III. J. G., white male, aged nine, entered the James Whitcomb Riley Hospital on Jan. 24, 1927, because of pain and tenderness in the left heel. Seven weeks previously he had fallen about 7 feet, most of his weight striking upon his left heel. Although disability was immediate the swelling was only moderate at the time. Marked swelling developed over the



A B

Fig. 3. Case 1. A. Normal right elbow, lateral view. B. Left elbow, lateral view.

posterolateral aspect of the os calcis about three days later, with temperature rising to about 101°F. On the tenth day after the injury, the family physician incised the area, releasing a large amount of pus and blood. The boy was still unable to bear his weight upon his heel at the time of entrance to hospital. The previous history was irrelevant.

Physical examination revealed a recently healed sinus on the external aspect of the left calcaneus, surrounded by bluish tumefaction.

Roentgen-ray examination, Jan. 25, 1927, gave a finding of apophysitis of the calcaneus and periostitis of the superior margin of the posterior portion of the calcaneus.

After a few days of rest in bed with hot packs he was able to walk normally except for a slight limp.

Further roentgen study was made on Dec. 3, 1927, and Aug. 31, 1928, at which times there was irregular and excessive ossification in the upper part of the calcaneal epiphysis. The lower portion had evidently been absorbed.

Case IV. J. M., white male, aged ten, entered the Long Hospital because of acute infection of the right femur and right hip joint. This patient had been disabled most of the time since the age of eight on account of osteomyelitis of the right tibia and metatarsals.

In the roentgen films of this patient a marked disturbance of structure and contour of the calcaneal epiphysis was found to be present, though the significance was not appreciated at the time. The association of epiphyseal lesions with pyogenic infections in other patients leads us to believe that there had been a calcaneal apophysitis which had healed before our first observation.

Case V. R. B., white male, aged five,

entered the Riley Hospital on account of osteomyelitis of the left tibia and right femur, present for seven months. The previous history was irrelevant.

Fig. 4. Case II. Suppurative apophysitis of tibia, showing roentgen appearance of Osgood-Schlatter's disease.

Roentgen films made the day after entrance showed the appearance of Köhler's tarsal scaphoiditis, in addition to the osteomyelitis previously diagnosed. Unfortunately the scaphoid changes were not observed until after the patient had passed from our observation and a film of the right tarsals is not available for comparison.

Case VI. V. G., aged twelve, was referred by Dr. R. J. D. Peters on account of pain in the second metatarsus. The first symptoms had occurred after a fall, shortly after which the entire extremity became greatly swollen and showed every evidence of infection but with no particular localization. A septic temperature lasted for about three weeks and the limb remained swollen for about another month. No operative interference seemed advisable.

Fig. 5. Case VI. Köhler's disease of second metatarsus following injury and infection.

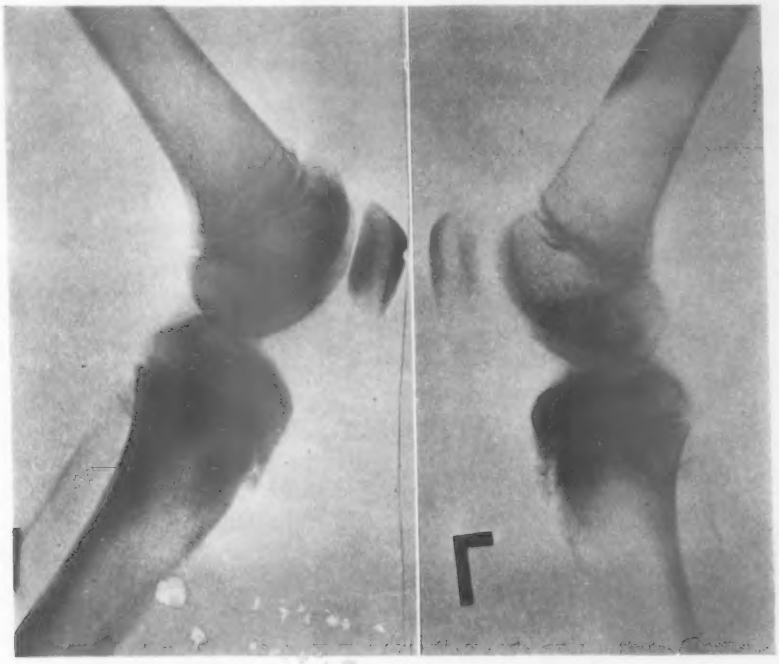
About three months after this the foot again became painful and the patient came for roentgen examination, when the typical appearance of Köhler's disease of the metatarsus was found (Fig. 5).

Case VII. M. P., white female, aged six, entered the Riley Hospital on Sept. 1, 1924, for reduction of a congenital dislocation of the right hip, which was accomplished without great difficulty.

Roentgen examination before manipulation showed normal bony structure in the epiphysis of each femoral head, considering the congenital dislocation. After operation she ran a septic type of temperature during her hospital stay, ranging up to 101.5°F. each day, the cause of which could not be determined. She was furloughed from the hospital March 31, 1925,

at which time she was rapidly learning to use the right extremity and the function seemed normal.

Roentgen examination April 25, 1925, however, showed definite evidence of Legg-Perthes' disease in the right hip and a cystic appearing change had occurred in the left femoral head.



A B

Fig. 6. Case ix. A. Probable tibial apophysitis in patient with multiple osteomyelitis. No local symptoms. B. Normal apophysis of opposite side.

The patient was re-admitted March 25, 1926, and until she was again furloughed on April 6, the temperature curve showed daily elevation as before.

Roentgen study Sept. 7, 1928, showed the right femoral lesion fairly well advanced in healing and the cystic appearing change in the left head disappearing. Examination of the other epiphyses at this time indicated disturbed ossification in the epiphyses of the 12th dorsal and the 1st and 2d lumbar vertebral bodies, probably of the nature of epiphysitis.

No local clinical symptoms have been produced by any of the epiphyseal disturbances here.

Case viii. G. McL., white male, aged five, entered the Riley Hospital May 25, 1927, suffering from pain in the left knee which had begun in January, 1925, and had gradually become worse. An afternoon rise in temperature had accompanied this. The left hip was not painful. There was no history of infection, contagious disease or injury.

The physical examination was negative except for limited flexion and absence of external rotation and abduction of the left femur. The von Pirquet test was negative, the Wassermann reaction strongly positive.

The temperature ranged up to 100° or 100.5°F. each day during his hospital stay, there were night cries, and the disability in the left hip became marked. During all this time he was taking intensive antiluetic treatment. In October there was well-defined anterior and posterior cervical adenitis and left inguinal adenitis. No symptoms or objective findings were noted in the right hip at any time.

In the roentgen films of May 25, 1927, there was the typical appearance of a well-advanced Legg-Perthes' disease and a less advanced lesion of the same type in the right hip. In June, 1928, there was involvement of the juxta-epiphyseal portion of the right femoral neck and definite epiphysitis of the right greater trochanter.

Case ix. J. H., white male, aged thirteen, entered the Riley Hospital on account of chronic osteomyelitis of the left femur and the right lower tibia. There were no local symptoms in the tibial apophyses.

Roentgen examination of the knees gave evidence of Osgood-Schlatter's disease of the right tibia (Fig. 6).

DISCUSSION OF CASES

Cases I and VIII illustrate the occurrence of multiple epiphysitis in patients with osteochondritis of the hip. Case VIII is one of bilateral involvement of the femoral heads. In Case I the coincident involvement of the elbow is assuredly not due to external injury, but it may readily be believed that injury or weight-bearing would produce considerable deformity here, as does the latter in the hip. In Case VII there is a definite association with probably direct injury and unusual static strain in that reduction of a congenital dislocation had preceded the appearance of changes in the head of the right femur. However, this does not account for the occurrence of a similar change in the opposite hip, nor for the persistent fever exhibited during all the period of observation. Case VIII also had a persistent fever, much disability and considerable night pain. The hip condition has not improved under antiluetic treatment, and we cannot believe it is luetic in nature. Cases II and III show frank infectious processes affecting epiphyses, resembling somewhat the case of calcaneal apophysitis reported by Lewin. Each of these patients suffered both trauma and infection, as did also Case VI, but in the latter there was no suppuration at the site of the bone lesion.

In Case IV there has been a marked disturbance in contour and growth of the calcaneal apophysis in a patient considerably disabled by osteomyelitis and therefore external injury can probably be fairly well excluded from consideration. The association with a blood-stream infection is at least suggestive. The same may be said of Case V. In Case IX there have been no localizing symptoms, but it would appear as though such might readily be precipitated by a little muscular strain and that their absence is only due to the physical inactivity enforced by the bone infections in other parts.

Although suppuration does not occur in typical adolescent osteochondritis,* Cases II and III are listed as showing a certain similarity between suppurative epiphysitis and the typical adolescent type. Case VIII seems to illustrate, in the same patient, intermediate degrees between the symptomless and the quite painful types, with local and general evidence of a relatively mild infection. Case VII, on the other hand, had few local symptoms, yet there were general evidences of infection with no other explanation.

The impression cannot be avoided here that, while other factors may quite probably operate in some cases, infection must be considered as a probable cause in many epiphyseal lesions. Robertson has shown that bacteria are present in large numbers in epiphyses after experimental intravenous injection of such organisms. Ordinarily the infection is readily overcome. A local lesion might reasonably be expected to develop more frequently upon the occurrence of trauma, interfering with the local mechanism of resistance, as is the case in osteomyelitis. The negative results which have been reported in the relatively few cases where cultures have been made do not disprove this possibility, inasmuch as negative cultures are often obtained in other conditions of long standing yet recognized as of known infectious origin.

* Since this paper was presented Dr. H. H. Inlow of Shelbyville, Indiana, has brought to my attention an instance of suppurative tarsal scaphoiditis occurring subsequent to pneumonia and empyema. Dr. Inlow will report the case in detail at a later date.

SUMMARY

1. A large group of epiphyseal lesions, commonly known as epiphysitis of adolescents, are considered by many observers to be fundamentally related in etiology and pathology.

2. The various theories as to etiology of this type of lesion are reviewed.

3. Several cases of silent epiphyseal lesions of unusual type are illustrated, which are probably more common than has been believed.

4. Lesions of various epiphyses are presented with such association with infection as to indicate that infection is a probable cause of many of this type.

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DISCUSSION

Dr. A. C. Christie, Washington, D. C. We gathered from Dr. Smith's paper that the question of the etiology of epiphysitis is not settled at all—that there are the three theories—trauma, infection and circulatory changes, each or all of which may have something to do with the condition. The opinion that is held seems to depend upon the interpretation which different men place upon their findings in cases that have been examined histologically, and the interpretations seem to differ according to the particular person's preconceived theories with regard to the cause of the disease.

For instance, one man will report a condition that looks typically inflammatory and another will report necrotic changes to support the idea of circulatory changes as the cause of the disease. Another is impressed by the infractions and collapse of the bone to support the theory that trauma is the original cause.

It seems clear, from the study that has been made in the past few years, that all of these diseases that have been mentioned by Dr. Smith today are probably the same disease; that is, that they have a like etiology. I think no one can examine a case, for instance, of Legg's disease and compare it with a case of Köhler's disease of the navicular bone, without seeing that they have a similar appearance. The flattening out of the epiphysis and the fragmentation and sclerosis that take place within it are strikingly similar in the different bones. It seems likely that not only Legg's disease and Köhler's disease of the navicular bone but also Schlatter's disease, the so-called malacia of the semilunar bone, Scheuermann's epiphysitis in the spine and the second disease of Köhler in the second metatarsal bone, probably all have the same etiology.

Dr. Smith spoke especially of Axhausen's theory, and it seems to me that this writer has done about as careful work as any man in the world on this particular disease. His theory is that the disease is really due to circulatory changes. It is known, of course, that the circulation of these epiphyses is from the periosteum, and that it has no connection with the circulation of the diaphysis of the bone. Just how that circulation is interfered with, even Axhausen has not been able to explain. It would seem likely, although there is no definite proof for it, that trauma must have something to do with the condition. It occurs in places where there is always some kind of chronic trauma, pressure or muscular pull or something of that kind.

This is borne out a little by the statement that Dr. Smith made and the observation that has been made by others that the second disease of Köhler, epiphysitis in the second metatarsal bone, is very common in women, while the disease in the navicular bone is much more common in boys than it is in girls. Perhaps the high heels and the position of the foot

makes pressure upon the head of the metatarsals in women. I think it is well established, and even Freiberg has stated in some of his later writings, that the condition is certainly not primarily an infraction of the head of the bone, that there is some disease of the bone which precedes it; all of which, I think, must lead one to believe that probably all of these factors operate in these cases.

Dr. Frank D. Dickson, Kansas City, Mo. I suppose I am here to speak on this subject from a clinical point of view as I am not a roentgenologist but just an orthopedic surgeon.

The reason why adolescent osteochondritis is so interesting is that we don't know what causes it. If we did, it wouldn't be nearly so interesting. Of course, as Dr. Smith has said, there have been a number of theories put forth as to the cause of this condition. I think we may say that rickets and syphilis have not held their place in the race, and that narrows the field down to endocrine disturbances, trauma and infection.

A number of years ago I was a very strong supporter of the endocrine theory as the cause of adolescent osteochondritis because we so frequently find associated with this condition the stigmata of endocrine disturbance, but I have come to believe, myself, that the endocrine disturbance as a factor is probably only of importance in that it may cause some changes in the epiphyses which may render them potentially vulnerable.

I think at the present time trauma and infection are looked upon as the most probable causative factors. Those who support trauma base their contention chiefly on the fact that in Perthes' disease, at least, the degeneration corresponds very largely to the distribution of the three terminal arteries and upon the fact, as brought out by Dr. Smith, that it is quite common to have this condition occur in a congenitally dislocated hip after reduction, ascribing the changes to the trauma of reduction. However, as Dr. Smith mentioned and as is indicated in one slide he showed, we occasionally, not so rarely, find similar changes in the hip which was not reduced and not subject to trauma of reduction. In fact, I have had the experience myself, in a fairly large number of cases, of finding degenerative changes similar to those in the reduced hip occur in the normal hip so that I do not feel that this is a particularly strong point in support of the traumatic theory.

The proponents of infection base most of their conclusions upon roentgen evidence and upon pathological findings chiefly those of Phemister, although his series of cases is very small, and the fact that Kidner was able to isolate a low-grade staphylococcus in one case he operated upon. These findings have never been repeated by any one or by Kidner himself.

I feel in the light of our present knowledge we must conclude that there is probably more than one cause of adolescent osteochondritis. That trauma does play a part, perhaps is the sole cause in some cases, is highly probable. That infection is also an important factor we cannot deny in the light of some of the evidence.

Based on clinical observations, I am inclined to believe that infection is the chief etiological factor in most cases, and that trauma probably plays the part of a predisposing cause, as it does in so many bone diseases.

My experience, clinically, in the last eight years has been that a large number of cases of osteochondritis of the adolescent type have been due to foci of infection, and I am inclined to believe that our old friend the tonsil is very largely responsible.

It has also been a matter of interest that we have had 5 cases in which chorea preceded or accompanied this condition and chorea is an infectious disease. From the clinical point of view, from our experience, and because of certain pathological evidence, I believe that as time goes on we will come to the final conclusion that infection plays the most important part as a causative factor of adolescent osteochondritis.

There is one point I should like to emphasize in Dr. Smith's paper as I think it should afford us a very important lead in the investigation of these cases, and that is the slide which he showed in which there was disease of this type in one bone, and films of other epiphyses showed the same condition in a bone remote from the one in which it originally occurred. It seems to me if we roentgenograph all the epiphyses in these cases we may get valuable information which may enable us to clear up the etiology of this important disease.

Dr. A. L. Gray, Richmond, Va. Like our last speaker, Dr. Dickson, I have concluded that trauma and infection are the causes of these conditions, except that I would prefer to make trauma the inciting cause and infection the predisposing cause. Having had a case of double Osgood's disease in my own family following trauma, and also following a more remote systemic infection, I am especially interested in the subject.

However, since we do not know exactly what the causes of these conditions are, I should like to add just a word of caution in the matter of diagnosis, especially of epiphysitis of the hip.

Some two years ago I had referred to me a typical fat boy about fourteen years of age with a probable diagnosis of tuberculous coxitis.

I was unable to demonstrate any lesions whatever either by direct examination of that hip or by comparison with the other. The joint spaces in both sides were perfectly clear, and I made a negative report. However, the orthopedist, thinking that he was dealing with a tuberculous infection of the cartilage or soft tissues about the joint, kept this boy in bed for six months, had him return for a second examination which showed an almost complete displacement of the epiphyseal head of the femur, a typical slipped epiphysis. Many of the orthopedists at least, state that treatment is of no avail. However, this orthopedist continued the bed treatment and in three months thereafter a second film showed the epiphysis returning to its normal location, and in six months thereafter it was almost impossible to tell he had had an epiphyseal separation at all.

Dr. Smith mentioned the so-called Scheuermann's disease, and I should like to add as a synonym, "Buchman's disease" because Dr. Buchman has studied and written so extensively about it. I think this condition is very much more common than is generally suspected.

When my attention was first called to this, and when I first recognized it, it occurred to me that I had seen the condition before and in going over many cases I found quite a number in which I had not recognized the condition.

Since vertebral epiphysitis is not necessarily a general condition but may be confined to one vertebral body, a word of caution may be added with reference to traumatism to the spine. I am inclined to think that I have diagnosed "compression fracture" of the vertebral column in the single vertebra when the condition was due to vertebral epiphysitis. Unless we find the condensation that is usual in a compression fracture we should be just a little careful how we make this diagnosis.

RADIOTHERAPY FOR TUMORS OF THE TESTIS*

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ROCHESTER MINNESOTA

THE impression of the relative infrequency of tumors of the testis is partly, if not largely, due to the circumstance that large metastatic deposits in the abdomen often overshadow the growth in the testis to the extent that the primary neoplasm may be overlooked. A diagnosis of abdominal tumor of indeterminate origin is sometimes made in the unsuspected presence of a readily palpable testicular tumor. On the other hand, unfamiliarity with the lymphatic drainage of the testis often causes the relation between tumors of this organ and secondary abdominal, supraclavicular, cerebral or pulmonary growths to be misunderstood. We owe our knowledge of the lymphatic drainage of this structure chiefly to Most, Cuneo, and Jamieson and Dobson, who studied it by carefully dissecting the lymph vessels and nodes after injecting dyes into the testis. The descriptions of Most and Cuneo differ only slightly from that of Jamieson and Dobson, but this apparently slight difference is of considerable import (Fig. 1). All three descriptions agree that the lymph channels which drain the testis follow the course of the spermatic vessels through the inguinal canal and along the brim of the pelvis and empty directly into a group of nodes around the aorta at the juncture of the right spermatic vein and inferior vena cava and of the left spermatic and left renal veins. The lymph nodes in the femoral or inguinal region do not receive lymph from the testis proper, but they drain the lymph from the scrotum.

The retroperitoneal nodes around the abdominal aorta, above its bifurcation, are distributed irregularly on both sides and in front of this vessel and act as primary filters. One or more small nodes are sometimes found at a lower level,

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

adjacent to the common iliac vessels, but these have never been found colored by the injected dye until after the primary para-aortic nodes were filled with dye.

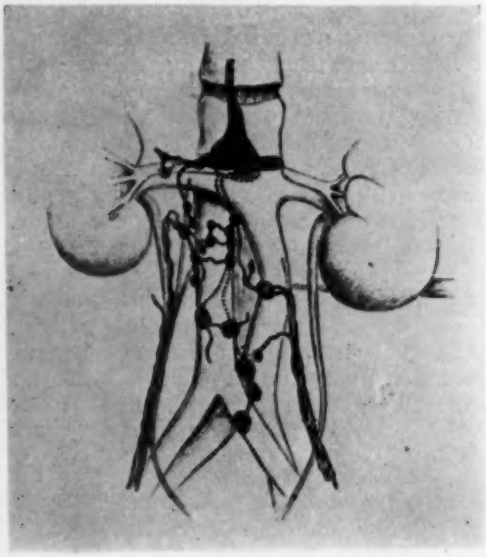

FIG. 1. Lymphatics of the testis; the anterior, lateral and posterior para-aortic primary lymph nodes; the upper iliac secondary nodes, and the nodes in the vicinity of the receptaculum chyli. (After Most.)

They constitute, therefore, the secondary line of defense, and do not become invaded until the invading process has passed through the primary nodes. Occasional variations from this arrangement may, of course, be encountered. The descriptions of Most, Cuneo, and Jamieson and Dobson agree closely to this extent. Besides the primary nodes on either side of the abdominal aorta, Most and Cuneo also found, behind this portion of the artery, one or two large nodes directly connected with those at the sides of the vessel and through which the dyed lymph from the testis passed to other nodes in close proximity to the receptaculum chyli. This part of the lymph stream then flows through the thoracic duct and empties into a single node or small group of nodes situated at the juncture of the duct with the left subclavian vein, into which the duct pours its contents. This distribution explains the invasion of the thoracic duct itself and of the so-called pilot node or nodes above the inner third of the left clavicle, which sometimes occurs in tumors of the testis. Jamieson and Dobson did not mention the nodes behind the aorta and their connection with the other para-aortic nodes, on the one hand, and with the thoracic duct, on the other (Fig. 2).

From this brief description of the lymphatic drainage of the testis it may be readily understood why tumors originating in this organ metastasize first to the para-aortic nodes in the epigastric and umbilical regions, where the secondary deposits are often confined for a long time; why the iliac nodes are invaded only after the neoplastic elements have passed through the primary para-aortic nodes, or after these nodes have become blocked by metastatic elements of the tumor; why the thoracic duct and the left supraclavicular nodes sometimes become the seat of secondary malignant deposits,

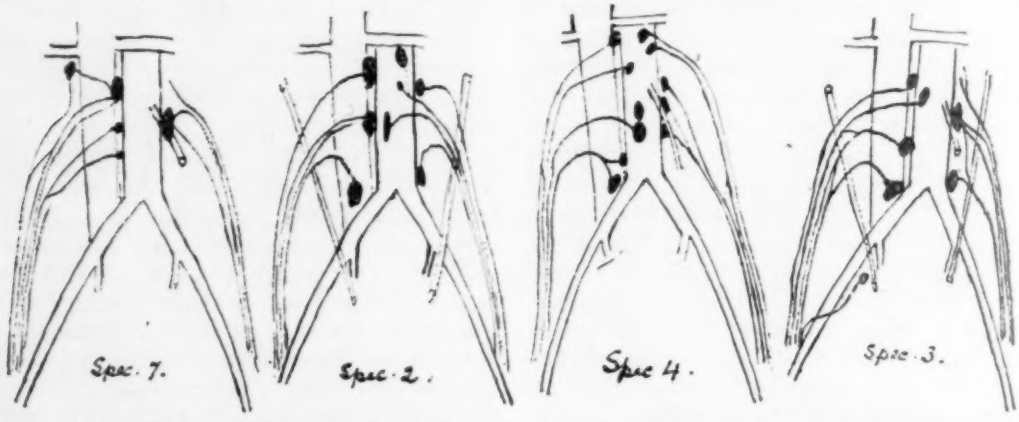

FIG. 2. Diagrams of para-aortic lymph nodes which drain the lymph from the testis. (After Jamieson and Dobson.)

and why the inguinal nodes become involved only when the tumor has spread beyond the testis and invaded the scrotum itself.

Fig. 3. Embryonal carcinoma divided through the center. The homogeneous aspect of the tumor is shown.

PATHOLOGY

The pathogenesis and classification of tumors of the testis are still unsettled. Many pathologists continue to regard a proportion of such tumors as sarcomas, in spite of the fact that true sarcoma of the testis is comparatively rare. This and the difference of opinion about the origin of testicular neoplasms have caused and are still causing much confusion among pathologists and other members of the profession. European pathologists in general have adopted the views of Chevassu, while American pathologists have tended to accept those of Ewing concerning the essential nature and classification of such tumors.

According to Chevassu and his followers the two chief varieties of testicular tumor are pathologically quite distinct. One, the most common variety, is a soft, solid, and comparatively homogeneous growth made up of large, round, oval or polygonal cells, with a large nucleus and a relatively small amount of protoplasm, closely resembling the spermatogonial cells of the normal testis (Figs. 3 and 4). The cells are crowded more or less closely together, and the intervening connective tissue stroma is

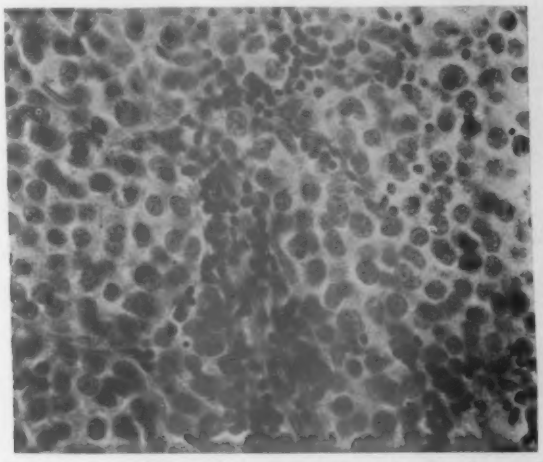

Fig. 4. The characteristic appearance of an embryonal carcinoma.

usually limited, although this necessarily varies according to the rate of growth of the tumor. Such neoplasms often display a considerable degree of lymphocytic infiltration. The close morphologic and chemical resemblance between the cells composing this kind of tumor and the spermatogonial cells of the normal organ caused Chevassu to regard it essentially as carcinoma and to give to it the apt designation of "seminoma," to indicate its origin from the spermatic epithelium. The second variety, not so common as the first, comprises a group of new growths, the common characteristic of which is that they contain elements or products of all three embryonic layers; hence the designation of embryoma (Figs. 5 and 6). Under this generic term Chevassu included mixed tumors in which the elements representing the three mesoblastic layers are indiscriminately mixed and not differentiated sufficiently to suggest definite organs, and also the more complex and more highly differentiated teratoma containing more or less fully developed structures suggestive of adult organs. The differences between these two extremes were regarded merely as variations in degree. In many such tumors one cellular element may outgrow the others and become the predominating feature of

the tumor. The epithelium of neoplasms belonging to this group often assumes malignant tendencies, and central degenerative changes are common. Chevassu

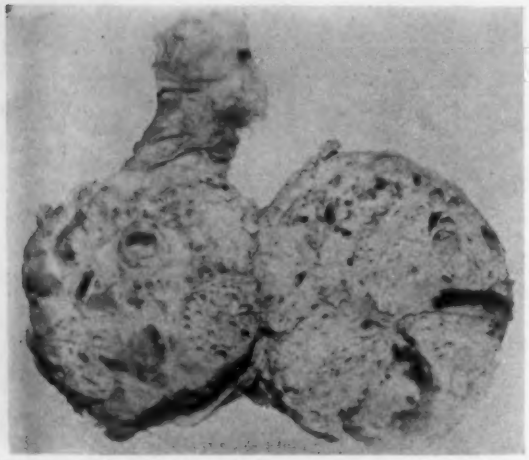

FIG. 5. Mixed, or teratoid, tumor showing multiple cystic areas of degeneration.

thus explained the occurrence in certain tumors of cysts, cartilage, myomatous, myxomatous, or osteomatous tissue.

The difference between the views of Chevassu and Ewing is largely one of nomenclature. Ewing divides testicular tumors into three groups: (1) the relatively benign and slow-growing teratomas composed of highly differentiated tissues arranged to suggest adult organs; (2) intermediate group including the less differentiated mixed, or teratoid tumors, and (3) the most common and most malignant tumor of the testis, often miscalled sarcoma, but which he designates as embryonal carcinoma. Ewing's pathological description of these embryonal tumors of the testis is identical with Chevassu's description of his seminoma; both regard it essentially as an epithelial cell tumor. The only real difference between them is that Chevassu definitely associates the development of this variety of tumor with the spermatic epithelium of the testis, while Ewing regards it as "a one-sided development of a teratoma and not derived from the adult spermatoblasts."

Of 101 tumors of the testis, the pathological features of which were recently reviewed by one of us (Morton), 69 were embryonal carcinomas (seminomas of Chevassu); 27 were mixed, or teratoid tumors; 2 were teratomas or testicular dermoids; 2 were sarcomas, and one presented features suggesting chorioma.

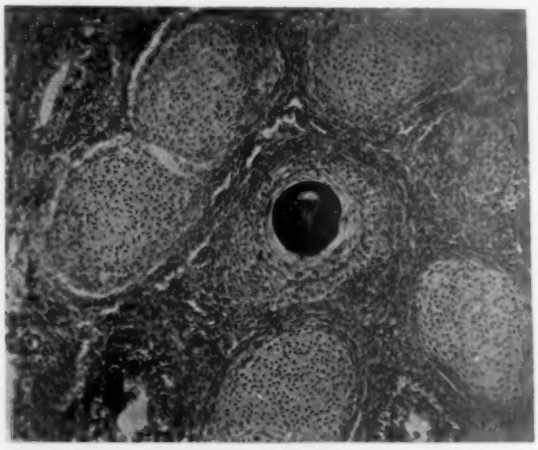

FIG. 6. Mixed, or teratoid, tumor showing circumscribed areas of cartilage.

CLINICAL CHARACTERISTICS

The recognition of the two main groups of tumors of the testis is important to the radiologist from the therapeutic and prognostic standpoints. As previously mentioned, the embryonal carcinoma (seminoma of Chevassu) constitutes by far the largest proportion of tumors of the testis. It grows rapidly, but does not often perforate the capsule of the organ for some time. The organ enlarges in all directions and may come to form a bulky, uniformly soft, oval or ovoid mass. The description of the metastatic tendencies of this variety of tumor given by pathologists, such as Ewing, is based largely on necropsy data, and does not represent the usual clinical features. Early metastasis is the rule, and such metastasis almost always involves first the para-aortic lymph nodes in the vicinity of the celiac axis, where bulky secondary growths develop. Secondary abdominal growths, of course, are generally situated on the same side as the involved testis. They consist of a mass of enlarged retroperitoneal nodes and tend, therefore, to be irregular and nodular. When situated mainly on the left side, they are not infrequently mistaken for enlarged spleen. Metastasis is generally confined to this region for a long time, but in a certain

percentage of cases malignant elements may also invade the secondary iliac nodes, or the left supraclavicular node or nodes through the thoracic duct, which sometimes also becomes involved. Metastasis to the lungs, brain, and other structures is a late complication and occurs only after the malignant elements have passed through the foregoing lymphatic channels. Rarely, the thoracic duct may become occluded by a solid mass, which may erode its thin wall and some adjacent vein, and malignant thrombi may be widely disseminated.

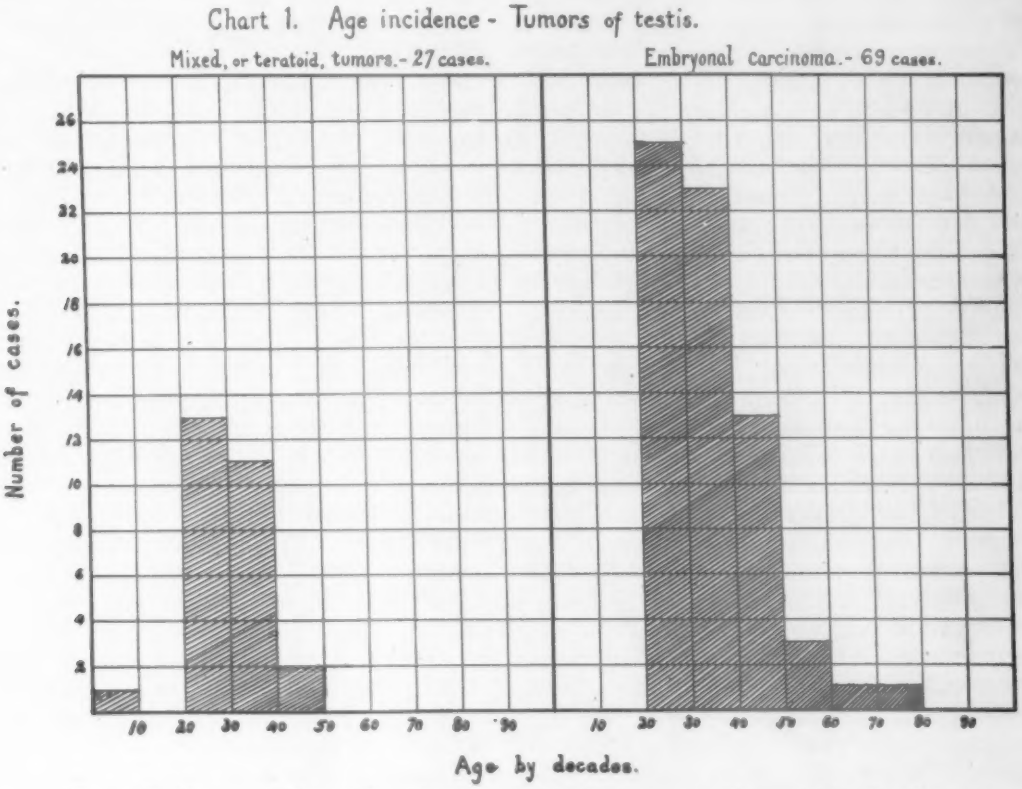
Chart 1. Age incidence - Tumors of testis.
Mixed, or teratoid, tumors.- 27 cases.
Embryonal carcinoma.- 69 cases.
Number of cases.
Age by decades.

FIG. 7. Incidence of embryonal carcinomas and of mixed, or teratoid, tumors by decades.

The second important group of testicular neoplasms, the mixed or teratoid tumors, comes next in frequency. They often appear to grow more rapidly than the embryonal carcinoma, often contain multiple cysts, embryonal cartilage, and areas of necrosis or hemorrhage, and are, therefore, much less homogeneous. Such tumors are characterized by a tendency of the cellular elements derived from one of the embryonic layers to outgrow the others and to develop true malignant properties. Consequently, their microscopic appearance varies according to the tissues which predominate in their structure.

The clinical course of true teratoma is slow. As Ewing states, "some are present at birth and enlarge slowly" until removed several years later. Malignant transformation of an adult teratoma is a rare occurrence.

The age incidence in cases of embryonal carcinoma and of mixed, or teratoid, tumors is shown in Figure 7. From this it is apparent that in both groups the incidence falls almost wholly between the second and fifth decades, but cases occurred as early as the first and as late as the seventh decade. The average age at onset of symptoms was thirty-six years in the embryonal carcinomas, and twenty-nine years and six months in the mixed, or teratoid, tumors. The average time between the onset of symptoms and operation, in 69 cases of embryonal carcinoma, was one year and seven months; it was only

six and a half months in 27 cases of mixed, or teratoid, tumor. So far as the time between the onset of symptoms and metastasis is concerned, the average for 33 cases of embryonal carcinoma was two years and four months. It is essential to point out, however, that in 23 of these cases metastasis occurred within two years, while in one case it did not occur until sixteen years later. In this last instance it seems doubtful that a malignant process could have been present for such a long time, but more likely that for much of this period the patient's symptoms were due to some benign lesion, such as hydrocele or partly undescended testis. The information furnished by the history is not explicit on this point. In the group of mixed, or teratoid, tumors, the average time between the onset of symptoms and metastasis in 16 cases was one and a half years. These data give the impression that the mixed, or teratoid, tumors are more malignant than embryonal carcinoma, but closer analysis shows that, while the mixed, or teratoid, tumors came to operation sooner than the embryonal carcinomas they did not metastasize so rapidly after operation. The mixed, or teratoid tumors, therefore, appear to grow more rapidly than the embryonal carcinomas, but it must not be forgotten that these tumors may exist for a considerable period before their malignant evolution manifests itself by growth so rapid as to attract the patient's attention.

When we tried to ascertain the time elapsing between the onset of the disease and death, definite information could be obtained concerning only 28 cases of embryonal carcinoma and 15 cases of mixed, or teratoid, tumor. In the embryonal carcinomas the average duration of the disease, from the onset of symptoms to death, was three years and two months; in the mixed, or teratoid, tumors the average duration was one and a half years. In this series of 101 cases, the tumor was apparently confined to the testis in 50; in many of these metastasis developed later, but we were not able to obtain sufficient information about this feature to ascertain the frequency of metastasis to different organs. In the remaining 51 cases, secondary growths involved the retroperitoneal, para-aortic lymph nodes in 39, there was metastasis to the abdominal para-aortic nodes, left supraclavicular "pilot" nodes and lungs in 7, and metastasis to the lungs without recognizable involvement of the retroperitoneal or supraclavicular nodes, in spite of careful clinical search in 5, in one of which the metastasis extended to the brain. It is probable that the retroperitoneal nodes were affected in the five last cases, but had not enlarged sufficiently to be palpable. In one of the cases in which there was metastasis to the retroperitoneal nodes and lungs, there were also secondary deposits in the ribs. Metastasis to the liver was recorded in one case, but this was based only on clinical examination. In one case orchidectomy had been performed for histologically proved carcinoma; later a tumor developed in the other testis and multiple subcutaneous nodules were scattered over the upper and lower extremities. The pathological appearance of one of these nodules excised from the region of the right shoulder was interpreted as neurofibroma. while examination of another nodule excised from the region of the knee showed lymphosarcoma. It is difficult to reconcile such varied lesions in the same patient.

Trauma as a possible etiological factor was mentioned in 16 of the 69 cases of embryonal carcinoma, in 6 of the 27 cases of mixed or teratoid tumor, in one of the two cases of sarcoma, and in one of the two cases of teratoma. Undescended testis was recorded in only 6 of the complete series, and 5 of these were embryonal carcinomas.

TREATMENT

Operation. Excision of tumors of the testis by simple orchidectomy has been chiefly relied on by surgeons, but this method of treatment yields, at best, not more than 10 per cent of permanent cures. The operation is simple and does not entail great risk, but metastatic deposits usually develop in the retroperitoneal nodes and elsewhere, just as if the primary tumor had not been disturbed. Not content with this rather unsatisfactory showing, a few enterprising surgeons have attempted more radical measures and

removed not only the affected testis, but also the para-aortic lymph nodes. Hinman appears to have been the outstanding and most successful exponent of this method, and his results are the best that have been reported. Such a radical procedure, naturally, is fraught with greater risk and entails a mortality rate which can hardly be called negligible. The difficulty of removing all the retroperitoneal lymph nodes which drain the testis has prevented many surgeons from attempting the operation. Jamieson and Dobson, in their description of the lymphatics of the testis, stressed the great practical difficulty of removing all these nodes. This difficulty appears still greater if the nodes behind the abdominal aorta and near the receptaculum chyli, described by Most and by Cuneo, are taken into account. It is not surprising that many of the best surgeons have been loath to follow the example of Hinman and have continued to limit their efforts to simple orchidectomy. Even though only a small percentage of patients treated in this manner remain well, such excision of the diseased testis is warranted provided careful examination does not elicit evidence of metastasis. To perform orchidectomy in the presence of retroperitoneal or other metastasis is useless and unjustifiable, except as a palliative measure of relief from an exceptionally large and heavy tumor. Cases are often encountered in which an obvious tumor of the testis has been tapped or incised on the diagnostic assumption of hydrocele. Not long ago we saw a patient who had had a right-sided hydrocele for many years. Only the presence of a large tumor in the epigastric and umbilical regions had prevented operation to eliminate the hydrocele. Palpation of the testis, through the fluid-distended scrotal sac, revealed a primary tumor in the testis and explained the abdominal neoplasm.

Radiotherapy. The only other method of treatment worthy of serious consideration is radiotherapy. The difference between the views of Chevassu and Ewing concerning the histogenesis of epithelial tumors of the testis is of decided interest to radiologists, because the remarkable influence of irradiation on these tumors seems to support the contention of Chevassu and his followers that they are, indeed, derived from the spermatogonial cells. The large number of animal experiments undertaken to ascertain the radiosensitiveness of the testis and of its different cellular components has long since established that, next to the lymphocytes, the spermatogonia of the testis are the most sensitive cells in the body. Anyone who has reviewed and analyzed this experimental evidence will not have the slightest doubt on this point. In this connection, it is of more than passing interest that the embryonal carcinoma of Ewing, or the seminoma of Chevassu, which includes almost three-fourths of the tumors affecting the testis, also is remarkably sensitive to irradiation. Still more significant, however, is the fact that the radiosensitiveness of this variety of testicular tumor is precisely the same as, or corresponds closely to, the specific radiosensitiveness of the spermatogonial cells of the normal organ. This susceptibility of the normal spermatogonia and of the similar epithelial cells, of which the embryonal carcinoma of the testis is composed, is so nearly the same as to make the possibility of mere coincidence doubtful. Such equal radiosensitiveness of the normal spermatogonial epithelium and its malignant derivatives appears to support rather strongly the contention of Chevassu that such tumors are, indeed, derived from the spermatogonial epithelium, especially if we bear in mind the analogous and well-established relationship between the radiosensitiveness of the normal lymphocytes and that of malignant processes affecting the lymphatic structures, a notable example of which is found in the group of tumors classified collectively as lymphoblastomas.

Testicular tumors of the mixed or teratoid group are influenced much less by roentgen or radium rays. Moreover, their susceptibility is a measure of the degree of epithelial preponderance in the cellular composition of such neoplasms. When cartilaginous, myxomatous, or fibrous tissue is an important feature, the influence of irradiation is slight or nil. True teratomas remain practically unaffected by irradiation.

The great radiosensitiveness of the

spermatogonial cells of the normal testis and the corresponding susceptibility to irradiation of the cells composing the most common variety of testicular tumor have ultimate prospects are concerned. Unless they have reached an advanced stage, the primary and secondary manifestations of this type of tumor can usually be made

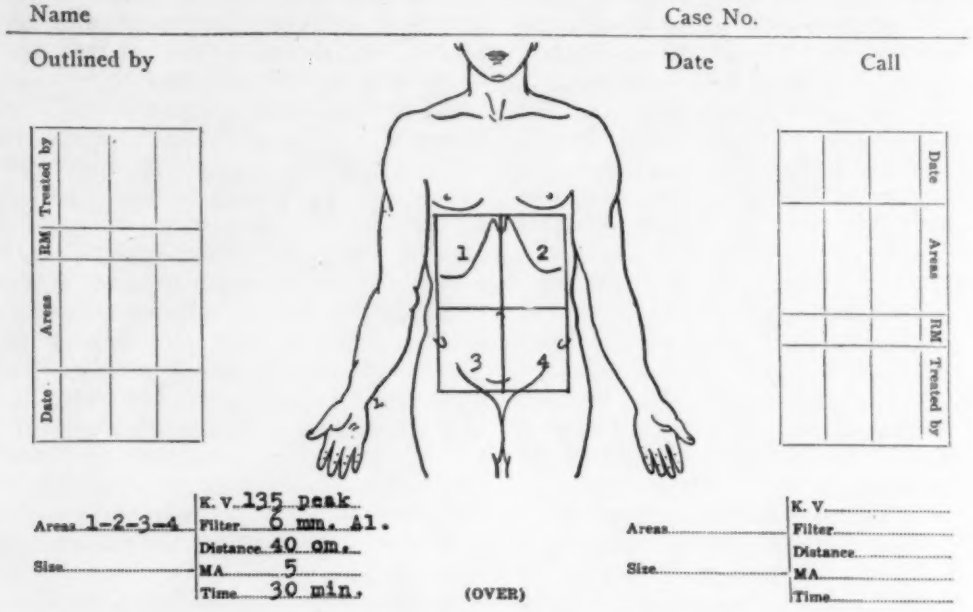

FIG. 8. Distribution and dosage of roentgen-ray treatment given after orchidectomy in cases of tumor of the testis without metastasis (anterior surface).

already been pointed out. Exposure of such tumors or of their secondary deposits to roentgen or radium rays causes them to retrogress rapidly. Such prompt and characteristic retrogression, indeed, constitutes a valuable means of distinguishing this from other varieties of tumors of the testis. If such differentiation could be made by clinical means, orchidectomy as a method of treatment would be unnecessary, because radiotherapy would be sufficient to cause the tumor to disappear. This, unfortunately, is not feasible, and since a small percentage of patients are permanently cured by surgical removal of the diseased organ, this operation must remain a useful measure when the malignant process is confined to the testis. When metastasis has occurred and surgical intervention is no longer indicated, however, radiotherapy can still render valuable therapeutic assistance. The assumption that the physical state of such a patient must be hopeless is unwarranted, so far as the immediate and sometimes even the to disappear, the general condition to return to normal, and the patient to remain well for from several months to several years. This naturally depends on the initial state of the patient, the degree of metastatic dissemination, the thoroughness of the treatment, and the faithful cooperation of the patient himself. No such temporarily favorable prognosis can be held out to bearers of mixed, or teratoid, tumors. These growths may contain a certain proportion of spermatogonial epithelium, to which the malignancy of the neoplasm may be partly or largely due, and may, consequently, exhibit a varying degree of radiosensitiveness. Nevertheless, their susceptibility to roentgen or radium rays is seldom so great and their subsequent retrogression never so rapid or complete as the embryonal carcinoma, or seminoma. This is undoubtedly due to the presence of tissues resistant to the rays, such as cartilaginous, fibrous connective, or myxomatous tissue.

The radiotherapy of tumors of the testis

must necessarily be varied according to the clinical circumstances of each patient. It is essential to consider first those cases in which the malignant process was apparently limited to the testis and in which orchidectomy has been performed. The tendency of the embryonal carcinoma of Ewing (seminoma of Chevassu) to metastasize rapidly suggests the possibility, if not the likelihood, that such unsuspected and as yet undemonstrable invasion of the para-aortic lymph nodes may already have occurred. Hence, it is desirable that the operation be followed as soon as possible by thorough irradiation of this portion of the lymphatic system. This can best be accomplished by means of roentgen rays. The number of fields depends on the quality of radiation employed. In general, rays of moderate wave length generated at approximately 135 peak kilovolts are preferable. This applies to patients of average size and weight and to patients below such average (Figs. 8 and 9). The anterior and posterior aspects of the abdomen, from the level of the xyphoid cartilage down to the pubo-inguinal region are each divided into four fields. If patients weigh 125 pounds or less each of the four anterior fields receives 5 ma. for eighteen minutes at a focal skin distance of 40 cm. The rays are filtered through 4 mm. of aluminum, and the four beams are made to converge toward the median line. The four corresponding posterior fields are treated in the same manner, except that the rays are filtered through 6 mm. of aluminum and the time increased to thirty minutes for each field. Patients weighing more than 125 pounds receive similar treatment, but in this case each of the anterior and posterior fields is treated with rays filtered through 6 mm. of aluminum for thirty minutes. If patients are large and heavy the four anterior fields are exposed to rays filtered through 6 mm. of aluminum for thirty minutes, but the corresponding posterior aspect of the body is divided into two large fields, approximately 20 by 20 cm. Each such field is exposed to roentgen rays generated at 200 peak kilovolts and filtered through 0.75 mm. of copper and 1 mm. of aluminum with 5 ma. of current for from sixty to seventy-five minutes, at a focal skin distance of 50 cm. A second similar course of irradiation is advised after four or six weeks, according to the technique employed.

When, because of metastatic invasion

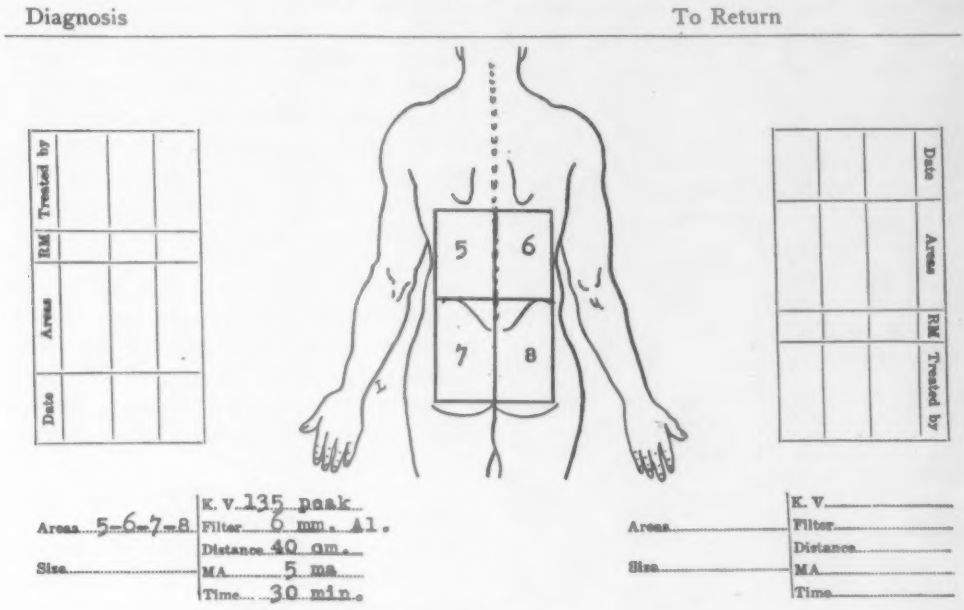

Fig. 9. Distribution shown in Figure 8 (posterior surface).

of the retroperitoneal, para-aortic nodes, the surgical removal of the primary tumor has become a useless procedure, the radiotherapeutic measures are much the same, but the testicular tumor is also treated, usually through two opposite fields. When metastasis to the left supraclavicular nodes has occurred, additional treatment is directed to this region and also to the mediastinum. Massive secondary tumors in the abdomen, with profound deterioration of general health, often disappear rapidly and are accompanied by recovery little short of miraculous. This improvement is sometimes maintained for long periods. The results in embryonal carcinoma are always better and more lasting than in the mixed, or teratoid, tumors. Roentgen or radium rays have little if any influence on true testicular teratoma. Radium also has an important influence on embryonal carcinoma of the testis, and the initial results of radium treatment are just as remarkable as those which follow exposure to roentgen rays. There is no question that well-planned and thorough treatment with radium is as effective as treatment with roentgen rays. Unfortunately, few institutions possess a sufficient quantity of radium to permit thorough treatment, which means more than the mere placing of a small pack of radium in contact with the skin of a limited area of the primary tumor or of secondary abdominal deposits. It is true that even such inadequate treatment is often followed by startling regression of the tumor, but the ultimate results are not so satisfactory. Roentgen treatment has the advantage of being less expensive and more generally available.

A comparison of surgery and radiotherapy cannot be made because they are used in different groups of patients. Radiotherapy is used only after surgery has exhausted its efforts or when, because the disease is too extensive, surgery cannot be employed. Occasionally, however, cases are encountered in which operation is refused or contraindicated, and thus we may hope to acquire in time some knowledge of the relative merits of surgery and radiotherapy. All that can be said for the present is that, in a small number of cases, surgical removal of the tumor results in permanent cure; that radiotherapy is a valuable method of treating inoperable cases or cases in which metastasis has occurred in spite of operation, and that the most common tumor of the testis, the embryonal carcinoma, is peculiarly and characteristically vulnerable to irradiation, thus providing a means of differentiating such tumors from other new growths affecting the testis.

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TWO SIMPLE METHODS OF PURIFYING RADIUM EMANATION*

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THE many advantages of using radium in the form of emanation for therapeutic purposes are well known. The types of apparatus hitherto used for purifying and tubing the emanation have usually been so complicated that their use has been restricted to a few large institutions where the amount of radium was great enough to justify the cost of the necessary apparatus and highly trained personnel.[1] There is undoubted need of an apparatus of low cost and simple operation to permit the wider adoption of the emanation method. In addition, such simplification would be of advantage in physical laboratories where radon is used for research purposes.

The emanation, as pumped off from an aqueous solution of radium salt is mixed with relatively large amounts of hydrogen and oxygen. If the emanation comes in contact with stopcock grease, some CO_2 is also generated. Oxygen is readily removed by ignition with hydrogen, while the CO_2 is taken up by KOH. There always remains, however, an excess of hydrogen, the removal of which constitutes the main difficulty in the purification of the emanation.

In the development of the apparatus described below, many of the usual details and complications have been found to be unnecessary. It is felt that its low cost and ease of operation by relatively unskilled technicians justifies this addition to the already rather long list of published descriptions.

In this apparatus, the use of liquid air has been avoided, and the purification is by purely chemical means. Furthermore, it was found unnecessary to remove the water vapor, so that the usual phosphorous pentoxide is dispensed with. This feature has permitted great simplification of the apparatus. The emanation is pumped from the solution into the simple purifying tube, and from there pushed directly into the fine capillary tube.

Two different methods of purification will be described. In the first, a hot filament coated with copper oxide ignites the oxygen with part of the hydrogen and oxidizes the excess hydrogen. The second method employs a spark to ignite the oxygen, while the excess hydrogen passes through the walls of a heated palladium tube into the outside air. In both methods crystalline KOH is used to remove the CO_2.

The apparatus has been in use for three years at the Victoria General Hospital, Halifax, Canada, with 200 mg. of radium. The concentration attained in routine operation is from 75 millicuries to 125 millicuries per cubic millimeter at a pressure of 25 cm. of mercury. This is ample for all therapeutic and most physical purposes, and is quite comparable with the purification obtained with much more complicated apparatus.[1]

METHOD I

The radium salt is dissolved in 75 c.c. of water in the flask labelled 1 in the diagram. The emanation and associated gases are withdrawn by the Toepler pump 4, and introduced into the purifying unit 11. The spiral filament shown is of platinum, copper plated and oxidized. When heated electrically to a bright red heat, it readily ignites the oxygen with part of the hydrogen and oxidizes the excess hydrogen. About 10 gm. of KOH fused in a thin layer around the inside wall of the purifying tube removes the CO_2 formed from the lubricant of stopcock 8 and union 9. The purified emanation is then forced up into the thin-walled capillary 12 by lifting the

[1] References to various types of purifying apparatus are given by Hess. *Phil. Mag.*, 1924, xlvii, 713. Another type of apparatus has been recently described by Curtis, *J. Optical Soc. Am.*, 1928, xvii, 77.

[1] An earlier emanation plant from which this apparatus was evolved is described by G. H. Henderson, *Trans. N. S. Inst. Sc.*, 1926, xvii, 14.

* This paper has also appeared in *Philosophical Magazine, London*, February, 1929.

mercury reservoir 7, and is sealed off with a small flame and removed. Most of the water vapor apparently condenses on the walls as the emanation is forced up into

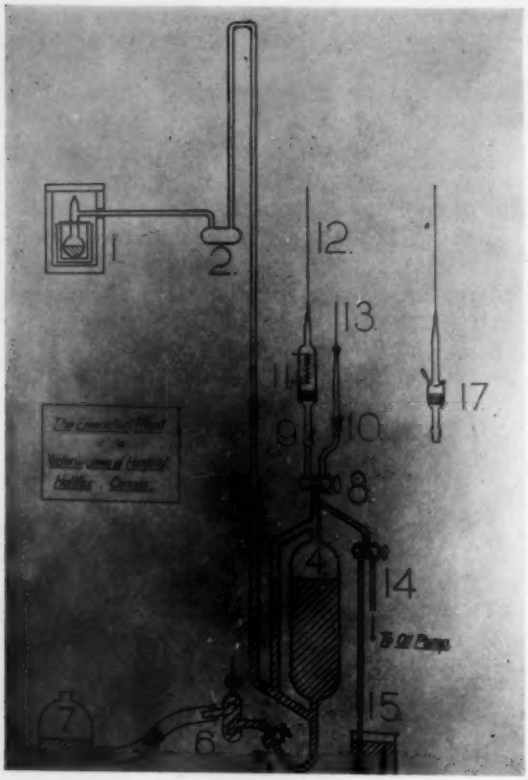

Fig. 1.

this tube. In the short section containing the purified emanation under a pressure of roughly 25 cm. of mercury, not more than 10 per cent of the volume can be water vapor.

When desired, a portion of the purified emanation may be allowed to diffuse back into the half-emptied pump cylinder 4 and introduced through the other arm of stopcock 8 into the capillary 13. A number of different sized capillaries mounted on interchangeable male sections of the ground glass union 10 may be attached, evacuated and filled from a single purification.

The details of the purifying tube are as follows: The body of the tube is 10 cm. long, 2 cm. diameter. The filament is of platinum wire, 20 cm. long, 0.20 mm. diameter, electroplated with copper to 0.35 mm. diameter, and wound into a spiral 5 cm. long. The platinum leads are 0.60 mm. diameter. The filament is heated by a current up to 4 amp. at 8 volts from a small laboratory transformer. The mercury film which adheres to the filament when the mercury is raised up around it is distilled off by a few seconds' heating when the mercury is lowered. The platinum core makes the filament rigid at red heat so that the usual quartz supporting rod is omitted, while its high melting point prevents easy burning out of the filament. Little trouble has been met with from alloying of the platinum and copper. Two such units in constant use for six months are still serviceable. The oxide coating is readily renewed by simply heating in air for a minute. One coating of oxide is sufficient for several hundred millicuries' purification. One coating of KOH is sufficient for several thousand millicuries. Quantities as low as 25 mc. of emanation have been handled, yielding concentrations as mentioned above. Greater concentration is obtained with larger quantities of emanation.

METHOD 2

In this method, the excess hydrogen passes through the walls of a heated palladium tube into the outside air.

The purifying unit 17 is attached at the interchangeable union 9, in place of unit 11. A palladium tube is sealed through the shoulder of the glass tube as shown. To heat this palladium tube, a current through a few turns of platinum wire 0.20 mm. diameter, wound on a mica sleeve, which slips over the tube, is used. The mixture of gases from the solution is introduced into the purifying tube in the same manner as in the previous method. A spark is passed between the inside end of the metal tube and a platinum wire sealed through the opposite shoulder. This unites the oxygen with part of the hydrogen. The palladium tube is heated, and the excess hydrogen passes through it into the outside air. Fifteen minutes' heating reduces the inside partial pressure from 1.0 cm. to 10^{-3} mm. of mercury. A layer of KOH removes the CO_2 as in the former method.

The purified emanation is then pushed

up into the thin-walled capillary, sealed off under a pressure of about 25 cm. of mercury and removed. Or it may be distributed among various sized capillaries attached in turn at the interchangeable union 10, and filled as before mentioned. Concentrations as high as 200 millicuries per mm.^{3} have been attained, though 125 millicuries per mm.^{3} is the usual concentration in routine operation. This type of unit is somewhat smaller than the copper-oxide filament type, has nothing to burn out and gives a slightly higher degree of purification. Seventeen months of steady use has not noticeably lessened the rate of passage of the hydrogen through the palladium.

The details of this unit are as follows: The body of the tube is 2 cm. long, 2 cm. diameter. The palladium tube is 1.2 cm. long, 2.5 mm. diameter, closed at one end, welded at the other end to a platinum tube of the same diameter, 2.0 cm. long. This welded tube was taken from an old type roentgen tube. The platinum end of the tube is sealed through the glass as shown. A current up to 4 amp. at 8 volts through the wire on the mica sleeve heats the palladium to around 250°C. About 10 gm. of KOH are fused around the inside wall as in the type just described.

The purifying unit is designed so that less than 1 per cent of the purified emanation is trapped in the palladium tube when the emanation is forced up in the capillary. The mercury film on the inside of the palladium tube is distilled off by a few seconds' heating after the mercury is lowered. No trouble has been met with due to erosion of the metal by the mercury.

It may be mentioned that at any stage in the procedure the emanation may be withdrawn from the purifying tube, pushed out through the delivery tube 15, and collected over mercury in the trough. The use of rubber pressure tubing between the levelling bulb 7 and the Toepler pump 4 has been intentional. It is felt that the use of heavy air pressures to move mercury in fixed apparatus is attended with very great risks. Attention may also be drawn to the position of the three stopcocks. With the pump cylinder 4 full of mercury and the stopcock turned off, the keys of each in turn may be removed for cleaning without spilling any mercury or letting air into the apparatus. The last is of some importance when small quantities of emanation are to be purified. Routine practice has been to clean stopcocks 5 and 14 every six months and 8 every month.

SUMMARY

A simple apparatus for the purification of radium emanation is described, which is low in cost and easy of operation. The use of liquid air is avoided and the removal of water vapor has been found unnecessary. Two different methods of purification are given. One method ignites the oxygen and hydrogen with a hot copper oxide filament which also oxidizes the excess hydrogen. The other method uses a spark to unite the oxygen and hydrogen, while the excess hydrogen passes through the walls of a heated palladium tube into the outside air. The emanation is pumped from the solution into the single small purifying tube and from there pushed directly up into the thin-walled capillary. The emanation may be withdrawn and collected over mercury at any stage in the purification. The concentration attained compares favorably with the results obtained with complicated installations.*

* The author's grateful thanks are due to Dr. G. H. Henderson, Dr. D. MacIntosh and Dr. H. L. Bronson, of Dalhousie University, for helpful suggestions and appreciated criticism. His thanks are also due to Dr. S. R. Johnson, radium therapist and Mr. W. W. Kenney, superintendent of the Victoria General Hospital, Halifax, Canada, for their kind and generous support in this research.

QUANTITATIVE CHARACTERISTICS OF LIGHT SOURCES USED IN ULTRAVIOLET THERAPY

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AS a physician interested in the application of radiation to human beings in health and disease, it seems that the problem of the pure physicist should be discussed as it bears on the practice of medicine and surgery. Thus, although there may be no reason to question in physics any division of radiation since all divisions are purely for convenience, it is a serious thing for the physician to be misled as to the characteristics of the radiator he employs in his practice. Thus, the arbitrary division of the zone we call ultraviolet into far, middle, and near ultraviolet may be perfectly satisfactory to physicists, but to the physiologist, which the physician essentially is, such a division is far from helpful. Although the name "vital ultraviolet" is open to criticism, the concept of a division in the ultraviolet which seems essential to animal and human welfare is well established. The zone from about 310 to 290 millimicrons, (multiply by 10 for Ångström units) is the zone of radiation from sunlight which is needed for the normal growth of babies. It is the zone which affects the calcium metabolism of pregnant women. It is the zone within which lie the radiations for sunburn and suntan. It has at least one of the lines which acts on the precursor of the antirachitic vitamin in otherwise non-active substances.

The physiologist requires a more natural division of the ultraviolet than is given by the physicist. I have suggested that these divisions be based on two set places in the ultraviolet: (1) the limit in natural sunlight which is about 290$\mu\mu$, and (2) the conventional barrier to glass of the ultraviolet which is about 320$\mu\mu$. The divisions would be:

Intravital Ultraviolet: 390 to 320$\mu\mu$, ultraviolet which passes through ordinary window glass.

Vital Ultraviolet: 320 to 290$\mu\mu$, ultraviolet present near noon in summer sunlight which does not pass through window glass.

Extravital Ultraviolet: Less than 290$\mu\mu$, (never present in sunlight) to the limit of penetrability of air, about 200$\mu\mu$.

Much labor and time have been expended in an attempt to study the various emanators used in practice, but unfortunately the actual needs of the physician have not always been met. The variants of amperage, voltage, cross-section diameter of carbon electrodes, and nonuniformity of the electrodes have been so numerous that it is not possible to compare them. The physician is seldom a physicist. He must of necessity be dependent on the physicist for his information, but the physician already has one variant which he is unable to dispose of, namely, the patient. Thus, to be truly of help, the work of the physicist should be as fool-proof as possible. Great injury may come if the physician is misled, as has already been the case, by accepting authoritative figures without analysis.

Well-devised experiments have given definite limits to the radiation producing sunburn and suntan. Thus, Hausser and Vahle found that when the living human skin is exposed to the radiation from the mercury vapor arc in quartz there was no irritation by the wave lengths longer than 313 or shorter than 289$\mu\mu$. The wave lengths which caused the reaction were between 310 and 289$\mu\mu$, with the greatest reaction about 297$\mu\mu$, and practically zero reaction less than 280$\mu\mu$.

My own experiments in erythema production through various glasses and other filters have been published.*

I believe that I have found in the fluorescence of irradiated skin a new method of studying this question, but am not prepared to dilate on it at this time. Likewise, experiments on living human skin may yet be successful in determining actual quantitative penetration.

My meager experiments with the

* *Arch. Dermat. & Syphilol.*, 1927, xvi, 291–293.

germicidal activity of ultraviolet rays have not indicated the action on bacteria which the published work would indicate. Certainly the bactericidal action of ultraviolet rays from the clinical mercury vapor arc in quartz source is not available in our work with diseases of the skin. I found that the time element for the destruction of organisms, as *Staphylococcus aureus*, is so great as to result in overexposure of the patient.

I would suggest that any germicidal activity of the long ultraviolet rays through glass has been a heat effect, especially since we know that the short ultraviolet rays have at best but a very slow germicidal action.

Attention should again be called to the fact that there is evidence sufficiently conclusive, of a distinct line of division at about 320$\mu\mu$, as the upper limit of the measurable health maintaining and health restoring vital ultraviolet. Hausser and Vahle, as mentioned, have definitely shown that erythema production is not forthcoming above 320$\mu\mu$. Hess likewise has shown that radiation of 320$\mu\mu$ or longer will not prevent rickets even if employed at very high intensity over extended periods of time. The same is true of activation of cholesterol, milk, spinach, lettuce, grain, oats, wheat, corn, oil, and foods in general.

Through the cooperation of William T. Anderson, Jr. we have been enabled to study at first hand the quantitative emanation of sources of radiation used in my practice. These sources of ultraviolet were measured by a series of quartz prisms and slits arranged to permit of the preselection of wave lengths. The energy of such wave lengths emitted by sources studied could then be actually measured by means of a thermopile and a galvanometer. The ergs of energy per millimeter square of area per second of time at 40 inches from the source were checked against a registered bulb of the United States Bureau of Standards. The results were obtained by passing the light through a quartz cell containing distilled water (which removed the long infra-red rays); then through a plate of Corning Corex, G 986 A (which transmitted only light from 245 to 410$\mu\mu$, and a little red and infra-red) and thence into the thermopile. The amount of transmission for the various wave lengths through filter G 986 A was carefully measured. It was therefore possible to correct for variations of transmission. Inasmuch as the red and infra-red which pass through the filter also affect the thermopile, it was necessary to apply correction which readily was made by passing the radiation through a Corning G 24 filter in addition to the quartz cell and G 986 A. Corrections were also made for the reflection of light from the quartz water cell, and for the glasses. As a result, there were 14 zones extending from 410 in the visible to 245$\mu\mu$ in the ultraviolet. A combination of these zones in the proper way gave us the information desired under the headings of intravital, vital, and extravital ultraviolet. The completion of a second monochromator has made it possible for Dr. Anderson to further correct the data.

TABLE 1

ULTRAVIOLET RADIATION IN ERGS PER SECOND PER SQUARE MILLIMETER AT 40 INCHES

(Fully corrected)

Type Lamp D.C.	Arc Volts	Arc Amp.	Arc Length, Mm.	Intra-vital 4000–3200	Vital 3200–2900	Extra-vital 2900–
Quartz mercury (200 hours)	75	3.4	55	7.51	9.46	3.26
White Flame "A" Therapeutic Carbon	35	17.0	15	7.34	0.72	0.21
Blue Flame "B" Therapeutic Carbon	35	16.0	13	7.06	1.61	0.96
Ni, Fe, Al "C" Therapeutic Carbon	43	16.0	8	19.57	4.15	1.98
Red Flame "E" Therapeutic Carbon	40	16.0	10	6.85	0.95	0.40
Tungsten "F" Therapeutic Carbon	38	16.0	7	7.20	1.35	0.63
Nickel "G" Therapeutic Carbon	40	16.0	11	9.26	1.61	0.41
Yellow Flame "H" Therapeutic Carbon	40	16.0	12	3.96	0.94	0.24
Cobalt "K" Therapeutic Carbon	40	16.0	15	5.80	0.83	0.30
Quartz Mercury A.C. (3 electrodes)	150	5.0	120	10.78	10.73	4.83

We now have available physical data to compare with clinical findings. The physican who uses the light sources as given in Table 1 has an actual understanding of the energy of the various zones in the ultraviolet reaching his patient. He is now able to consider how much radiation in the ultraviolet is effec-

tive radiation of the vital ultraviolet zone, and how much of that radiation in the ultraviolet has no effective reactions recognizable and measurable. With further study of the conventional sources of radiation in this manner we will be prepared to give quantitative estimation of dosage which to date has been empirical.

My contention is that the physician using ultraviolet radiation must learn *how much* of the radiation of the ultraviolet emanators is *vital* ultraviolet. We must not be satisfied by division into coarse bands of infra-red, visible, and ultraviolet. We must know more than that. Moreover, we must not be misled by divisions into near, middle and far ultraviolet. We now have the opportunity of asking what share of the emission of the apparatus lies in the zone from 290 to 320$\mu\mu$. We must then learn by experience the factors of time and distance. With these four factors,—quality, quantity, time and distance,—we can reproduce effects and advance the field of phototherapy within the limits of the variant factor of the patient.

A fifth factor has been added to these enumerated. The concept of vital ultraviolet on which the division for the published figures is based requires consideration at this moment. Everything in modern light therapy points to the factor of *specificity*. The term vital ultraviolet is retained, for by it we mean vital to one of the measurable biological reactions. Expressed in this manner, we foresee that it will not be long before each biological reaction influenced by ultraviolet radiation will be found to depend upon a specific portion or range of frequency or wave length of ultraviolet, for example. The same or similar specificity will be uncovered for other portions or ranges in our therapeutic applications. Many biological reactions may be influenced by some portion or range of frequency, perhaps within the ultraviolet, which we do not now recognize, or which we are unable to measure.

The new field of photechy* has a distinct bearing on this specificity of vital ultraviolet because radiation for it must be of determined frequency to be effective.

I have found a simple analogy between the radiation frequencies or wave lengths from therapeutic ultraviolet emanators and radio broadcasting to help explain specificity. Just as radio broadcasting stations are received at particular specific places on our radio receivers so that by turning the dial to a known number we are tuned to a particular broadcasting station, so effective biological vital ultraviolet depends on specific particular wave lengths or frequencies for its measured or measurable biological reactions.

The table published at this time, fully corrected by Dr. Anderson, for the various emanators listed is useful with this concept of vital ultraviolet.

* Photechy is the term used to signify that activation of otherwise inactive substances by the use of invisible vital ultraviolet so that these irradiated substances, in turn, act upon the body of human beings and animals as if they had themselves been irradiated. Photechy will soon be as well known as vitamin.

Vol. XXII, No. 2

ANGIOSARCOMA AND MYELOMA

TWO UNUSUAL CASES

BY ROBERT S. STONE, M.D.

Visiting Roentgenologist, University of California Hospital

SAN FRANCISCO, CALIFORNIA

As a result of the work of the Registry of Bone Sarcoma many cases of bone tumors can now be diagnosed fairly easily by means of clinical observation and roentgenograms. Rare and unusual cases, however, appear quite frequently. The following two cases seem sufficiently interesting to report.

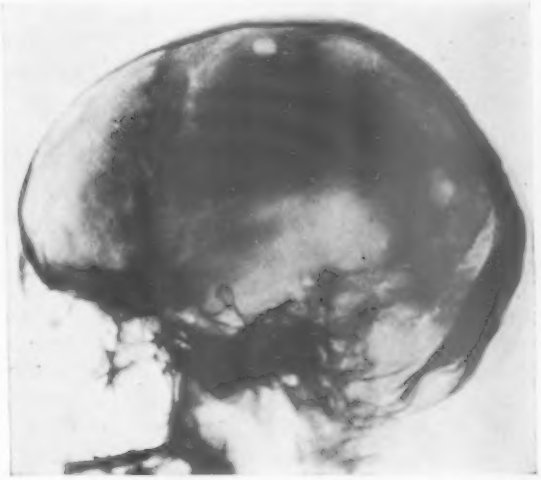

Fig. 1. Angiosarcoma. The skull shows two "punched out" areas.

Case 1. A white male, single, aged twenty-five, was admitted to the hospital with the complaint of pain on the left side of the head and the right side of the chest. He was a laborer, had always lived in California, and gave an irrelevant family and past history. About two and one-half years ago, he first noticed a sharp pain on the right side of his chest anteriorly. About the same time he noticed some nodules on his right ribs. This pain has continued irregularly. About one and one-half months ago, he began to have pain of an intermittent character in the left posterior parietal region. He has lost 19 pounds in weight in three months. Physical examination revealed some nodules on the right ribs and tenderness over the left posterior parietal region. There was poor strength in the right arm. A left scoliosis in the dorsal region was associated with a spasm of the right paravertebral muscles. The blood showed a slight degree of secondary anemia.

The roentgen examination showed small, roughly circular areas of rarefaction, not exceeding 2 cm. in diameter, in the heads of both femora, in the pelvic bones, in the right auricular process of the first dorsal vertebra, in the lower end of the right ulna, in some ribs, and three in the skull (Fig. 1). These areas appeared as if punched out, with very slight bone reaction about some of them in the form of slightly denser rings. The chest films showed the most peculiar appearance, being riddled with small shadows a few millimeters in diameter. Each of these shadows was formed of one ring, or concentric rings of calcium density (Fig. 2).

Fig. 2. Angiosarcoma. The chest shows diffuse involvement.

A biopsy of one of the firm nodules from a rib was diagnosed as angiosarcoma (Dr. C. L. Connor).

For comparison with this case, Figure 3 shows the hand of an unpublished case of

angioma in which attention is directed to the same ring-like structures in the soft tissue.

Case II. A white female, married, aged fifty-four, was admitted to the hospital, complaining of so much pain that it could not be localized. Her mother died of cancer at the age of forty-five. The patient had lost 45 pounds in six months, during most of which time she had been in bed. Five months before admission she suddenly lost control of her right arm, and two weeks later of her left arm. She complained of pain in her legs for two weeks more and then went to bed and had not been up since. There was a marked neurotic element. On examination, the patient complained of pain wherever touched. On lifting the arms, one got the impression that for a short distance below each shoulder there was no humerus present. There was no Bence-Jones reaction of the urine. The blood revealed a secondary anemia and slight leucocytosis.

Fig. 3. Angioma. Shows areas similar to those in the chest in Figure 2.

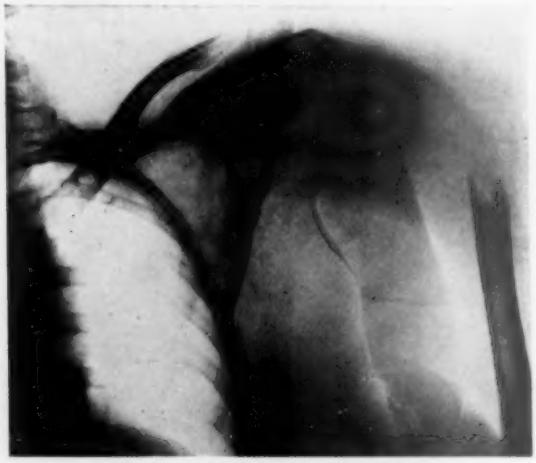

Fig. 5. Myeloma. Left shoulder.

Fig. 4. Myeloma. Right shoulder.

Fig. 6. Myeloma. Left acetabular region. The marks above the left femur are artefacts.

A roentgen examination was made of all the bones. About 4 inches of the upper end of each humerus from the anatomical neck downward was found to be missing. There was no evidence of periosteal bone formation or of calcium deposits in a tumor. The ends of the shafts were quite jagged and showed no clear

cut separation between the base and the area from which it was missing. The left acetabulum was entirely missing in the same manner as were the sections of the humeri. Adjacent parts of the left pubic bone and ischium were missing.

At post mortem fairly solid fusiform tumor masses were found in the regions from which the bone was missing. There was one tumor nodule in the spleen. The cells of these tumors were totally undifferentiated. The pathological diagnosis was myeloma (Dr. C. L. Connor).

CONGENITAL CYSTIC LUNG*

CASE REPORT

BY DOUGLAS N. GIBSON, M.D.

MADISON, WISCONSIN

THE following case is reported primarily because of the exceeding rarity of the condition. The modern medical textbook generally fails even to give it mention.

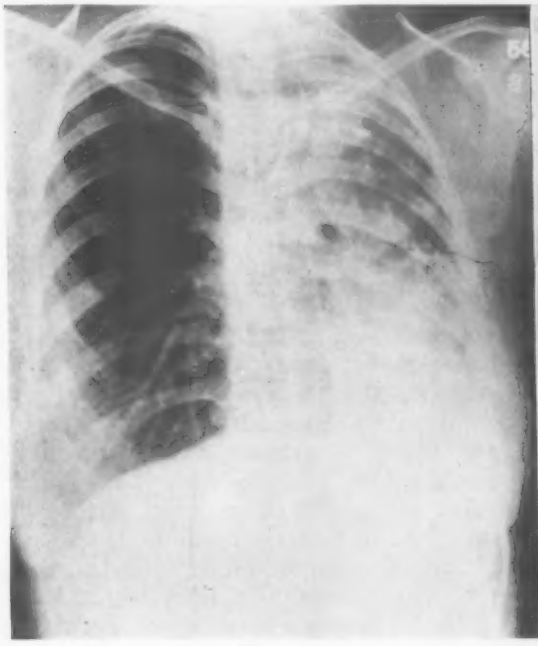

FIG. 1.

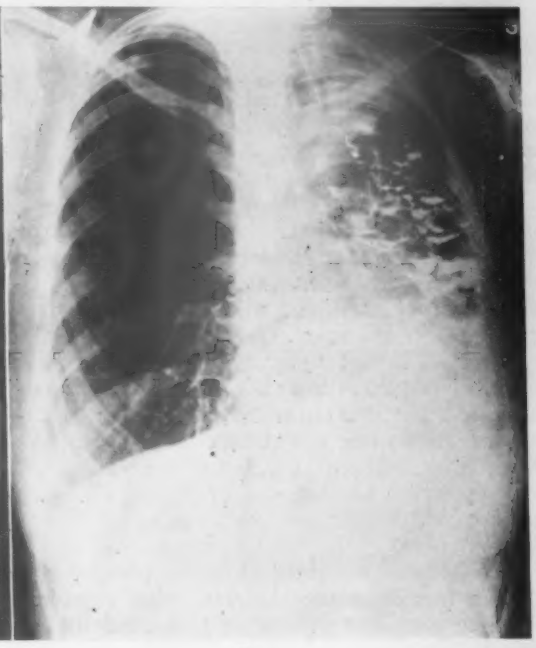

FIG. 2.

B. E., aged nineteen, Jewish female student, was admitted to the University Infirmary on March 7, 1928, for study. Her chief complaint was a "slight cough."

Her birth history was entirely negative and development was normal. As long as she could remember, she had always had a hacking cough. It had never been excessively productive, and when sputum was present, it was of a thick, tenacious, green type. She had never experienced hemoptysis nor suffocating spells. Up to three years previous to admission, she had been underweight, but since that time had gained 25 pounds without apparent reason. She had always noticed some shortness of breath and her voice had always had a husky tone.

Her past medical history was irrelevant except for that pertaining to the respiratory system. At three years of age she had double pneumonia with pleurisy. Following this, "colds" were frequent. At six, while under anesthesia for tonsillectomy, she vomited pus.

* From the Department of Student Health, University of Wisconsin, Madison.

She suffered from influenza during the epidemic of 1918, without complications. Her family history was entirely negative.

Physical findings exclusive of the chest were

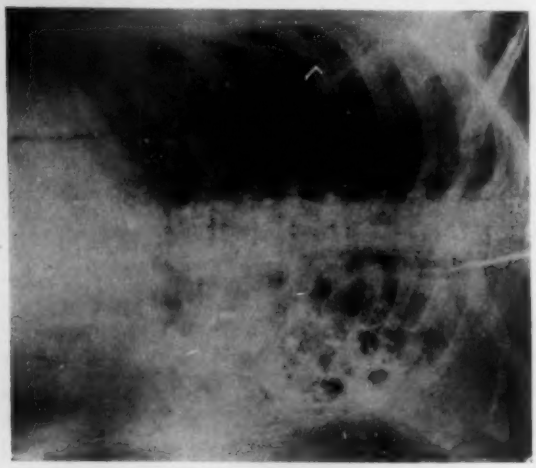

FIG. 3.

without bearing in the present relation. Chest examination showed the infraclavicular depression deeper on the left; expansion fair, right greater than left with a lag on the left. The percussion note was hyper-resonant over the entire right lung. On the left, it was high pitched over the apex and down to the fourth rib anteriorly. Below this the note was flat. Tactile fremitus and vocal resonance were increased over the area of impaired percussion. On auscultation, loud, harsh bronchial breathing was heard at the left apex. Over the whole of the left chest both anteriorly and posteriorly, loud crepitation could be heard. This was ever changing in intensity and character, usually synchronous with respiration but at times heard when the patient was not breathing. On several occasions, this crepitation was heard over the right lobe of the liver anteriorly and over the epigastrium. After a period of rest, it would disappear only to be present again after the patient had taken a few deep breaths. Her vital capacity was 2400 c.c., or 73 per cent of her calculated normal.

Laboratory tests showed the sputum repeatedly negative for tubercle bacilli and fungi. The urine showed a trace of albumin on admission but was subsequently normal. The blood count and blood chemistry were normal, and the blood Wassermann negative. Her temperature, pulse and respiration were normal during her stay in the hospital.

A reading of stereoscopic films of the chest was reported as follows by Dr. Wm. S. Middleton (Fig. 1).

"Trachea drawn over entirely to the left of the spinal column. Heart not visualized. The right lung shows slight peribronchial increase and is definitely over-ventilated. Diaphragm is depressed and slightly irregular. There is marked discrepancy in the sizes of the two chests, interspaces being narrower and the entire left chest smaller. There is no normal lung visualized on this side, but a considerable increase in density of a diffuse hazy nature off the hilum and extending irregularly parallel to the side. The diaphragm is not visualized. Throughout the lung field and particularly clearly visualized lateral to the above described haze, is honey-combing."

Lipiodol insufflation was then done and roentgenograms made. Figure 2 shows the plate taken with the patient in the upright position. In this, the contrast medium is seen to partially fill thin-walled cavities of various sizes in a peculiar semilunar fashion. In Figure 3, a plate is shown taken with the patient lying on her left side. In this, the semilunar levels have changed position to present crescentric borders dependently and fluid levels superiorly, as determined by gravity as in Figure 2. Practically the whole of the left lung is involved in the process.

In the differential diagnosis, the common causes of cavitation of the lung such as tuberculosis, lung abscess, bronchiectasis, fungus infections and metastatic neoplasm, are readily ruled out as etiological factors because of the lack of clinical symptoms and laboratory findings to explain the gross amount of pathology. The roentgen ray, too, is not typical of any of these conditions. Cystic lung seems to be the most plausible explanation of the picture presented by this case. Is it congenital? As far as can be determined, mild symptoms date from early childhood.

It is the general impression, I believe, that congenital cystic lung is fatal early in life. Miller[1] recently reported two such cases. However, Koontz[2] has ably reviewed the literature on this subject. His review of 108 cases based on autopsy findings showed the condition present in persons varying in age from premature stillbirths to old age. The sexes were equally affected. Involvement of both lungs was present in approximately one-fourth, the right

[1] Miller, R. T. Jr. Congenital cystic lung. *Arch. Surg.*, 1926, xii, 392–405.

[2] Koontz, A. R. Congenital cysts of lung. *Johns Hopkins Hosp. Bull.*, 1925, xxxvii, 340–361.

lung in one-fourth and the left lung in one-half the cases. It is also interesting to note that in the majority of cases in older persons, symptoms referable to the lung condition were lacking.

This case meets the requirements both clinically and roentgenologically of a cystic lung of the congenital type and for lack of establishment of another definite etiological factor, is considered such.

FRACTURE OF LUMBAR TRANSVERSE PROCESS

CASE REPORT

BY FREDERICK E. DIEMER, M.D.

DENVER, COLORADO

FRACTURE of lumbar transverse processes is usually unilateral and quite frequently multiple. It is due to violent sudden muscular action (penetrating trauma excepted) and occurs through the base of the process or at any location along its course, as a transverse or slightly oblique break.

The distal fragments are without exception displaced downward, because of the fact that the belly of the attached musculature with its greater range of movement, is below. The psoas increases in size and strength below each process attachment.

I wish to report the following case because of the peculiar nature of the fracture and because of a mistaken opinion that the fragment was displaced upward.

Mr. P., aged twenty-five, a coal miner, was "jack knifed" forward, between the roof of a tunnel and a loaded coal car. The roentgenologic examination revealed a right anterior compression of the fourth lumbar segment and a supposed fracture of the left transverse process of the fourth vertebra with upward displacement. Subsequent examination at St. Luke's Hospital, through a heavy cast, confirmed the diagnosis of compression fracture together with the break of the transverse process. However, the upward displacement caused considerable discussion, pro and con, until a roentgen examination after removal of the cast demonstrated the true condition. The compression fracture was depicted as was expected from the study of the roentgenograms previously made while the body cast was in place. The process fragment was identified as a half portion split from the anterior aspect of the third segment, with downward displacement.

The apparent absence of the left process of the fourth segment was caused by a right mid-dorsal scoliosis with slight rotation, causing a superimposition of the shadows of the plaster cast. The site from which the fragment was detached was identified by a comparison

FIG. 1. Compression of the fourth lumbar segment. Longitudinal split of the right transverse process of the third segment with downward displacement. Note the apparent six processes on the left side.

of the lengths and breadths of the right and left processes of the third vertebra and by stereoscopic recognition of the uninjured left fourth process.

The peculiar nature of the process trauma (longitudinal split) with final proof of downward, rather than upward fragmental displacement, prompts this presentation.

A CASE OF BURN FROM HIGH VOLTAGE CURRENT

BY A. T. NISBET, M.B.

BRISBANE, AUSTRALIA

DR. B. L. W. C., when screening an abdominal case in the roentgen room, found that the patient had on a metal truss. Telling him to take the truss off, in the dark, the patient did so, but instead of handing it to the doctor, he dropped it over the back of his head, thereby crossing the Coolidge filament wires to a metal couch. On using the foot-switch 90,000 volts at 8 ma. passed through the operator from the left foot to the left hand. Unconsciousness resulted and the operator fell to the floor thus breaking the circuit.

When I saw the doctor, about a quarter of an hour afterwards, he was in a condition of collapse, with extreme pallor. He had already been given an injection of digitalin. The sole of the boot was charred completely through, and the sock had a hole in it measuring about 2 inches in diameter.

There was no pain in the foot or in the hand. The doctor was put to bed, but insisted on returning to work the next day, saying that he was still suffering no pain, but he still appeared somewhat shocked. About sixty hours after the accident the pain became severe and the sole of the foot somewhat swollen. There was then seen the condition shown in Figure 1, a hard crusty surface somewhat like a wound produced by a cautery. There was also a small area burnt about 3 inches above the ankle joint, apparently where the leg had been touching the couch. This, with the foot, was dressed with spirits the first week. The burn on the leg rapidly became septic and at the end of the week there was some periostitis of the tibia. At an early date a slough of the sole of the foot commenced. Glycerine and ichthyol dressing was then used. The pain was very severe and the patient remained in bed for about five weeks. After the slough had separated there was a deep ulcer of the sole of the foot which gradually healed and at the end of five weeks the doctor was able to return to work.

Figure 1 shows the condition forty-eight hours after the accident. Figure 2

FIG. 1. Shows condition forty-eight hours after the accident.

FIG. 2. Shows the condition seventeen days after the accident.

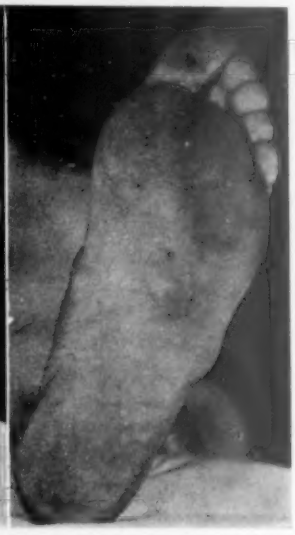

FIG. 3. Shows the healed foot.

shows the condition seventeen days after the accident. Figure 3 shows the healed foot.

There is still a well marked keloid which interferes, to some extent, with the movement of the tendons of the sole of the foot, and is, I think, beginning to act on the knee joint articulation on account of the angle with which the foot is placed to the ground.

The only comment I have to make is that despite the fact that the subject became unconscious, there was no cardiac failure and he is alive today.

ERRATUM

Through an error the following illustrations were omitted from the article on "An Introducer for Lipiodol in Lung Mapping" by M. C. Myerson in the July number of the Journal, page 69.

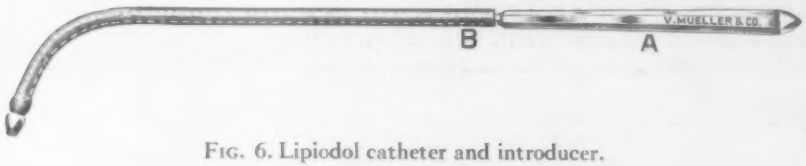

Fig. 6. Lipiodol catheter and introducer.

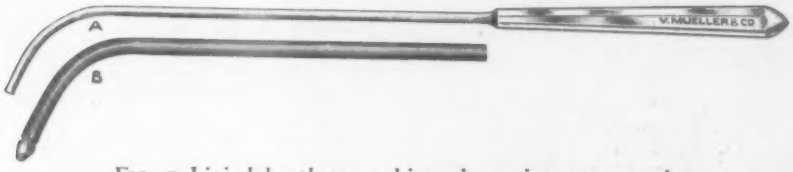

Fig. 7. Lipiodol catheter and introducer shown separately.

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Information of interest to all readers will be found on page ii.

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EDITORIAL

REQUIREMENTS FOR AN APPROVED DEPARTMENT OF RADIOLOGY OR ROENTGENOLOGY

IN the *Journal of the American Medical Association* for June 1, 1929, p. 1862, there is published "Essentials of an Approved Department of Radiology or Roentgenology," prepared by the Council on Medical Education and Hospitals of the American Medical Association.

These requirements are fully in accord with the opinions expressed in our editorial in the June number of this Journal and it is believed that they will be found exceedingly satisfactory to every roentgenologist who has at heart the progress of his specialty.

The importance of the subject justifies the publication here of the complete report of the Council on Medical Education. Attention is directed especially to the section on "Ethics, Fees and Publicity."

INTRODUCTION

At the Minneapolis Session of the American Medical Association, held in June, 1928, the Council on Medical Education and Hospitals was directed to extend its activities in regard to the approval of clinical laboratories so as to include departments of radiology and roentgenology, as this branch of medical activity occupies the same relative position in medical practice and procedure as does the clinical laboratory.

In this work the Council desires to cooperate in every way possible with those engaged in radiology and roentgenology, for the improvement of this type of service. The Council does not claim to have, nor does it assume, any legal authority over such departments, but it recognizes clearly that the officers of such institutions have the unquestioned right to conduct their work in the way they deem wise. If the department of radiology, or a physician specializing in this field, desires to have the Council's approval, however, it or he should not be unwilling to comply with the principles which the Council deems necessary for such endorsement. These "Essentials" have been prepared by the Council, therefore, with the sole intention and desire of dealing with equal fairness with all such departments.

1. DEFINITIONS

Radiology.—The branch of medicine which deals with the diagnostic and therapeutic application of radiant energy, including roentgen rays, radium, ultraviolet rays and other spectral radiation.

Department of Radiology.—The department of a hospital, clinic or other institution, organized and equipped for the diagnostic and therapeutic application of radiant energy, including roentgen rays, radium, ultraviolet rays and other spectral radiations.

Radiologist.—A qualified physician who also has obtained adequate special training and experience in general radiology.

Roentgenology.—The phase of radiology which deals with the diagnostic and therapeutic application of roentgen rays only.

Department of Roentgenology.—The department of a hospital, clinic or other institution organized and equipped for the diagnostic and therapeutic application of roentgen rays only. A department organized and equipped solely for the diagnostic or therapeutic application of roentgen rays shall be known as a department of diagnostic or of therapeutic roentgenology, respectively.

Roentgenologist.—A qualified physician who has had adequate training and experience in the diagnostic and therapeutic application of roentgen rays.

Diagnostic Roentgenologist.—A roentgenologist who limits his practice to the diagnostic phase of roentgenology.

Therapeutic Roentgenologist.—A roentgenologist who limits his practice to the therapeutic phase of roentgenology.

Radium Specialist.—A radiologist who specializes in the therapeutic use of radium.

Private Radiologic Laboratories.—The principles herein which refer to a hospital department of radiology should be construed as applying with equal force to a private laboratory of radiology.

2. PERSONNEL

(*a*) *Director.*—The director shall be a graduate of a medical school that is approved by the Council on Medical Education and Hospitals and shall be licensed to practice medicine in the state in which his department is located.

He shall also have had special training, such as is approved by the Council, in radiology or roentgenology at an acceptable school—preceptorship, hospital or clinic, department of radiology or roentgenology—for a period of at least three years, or, in lieu of such training, shall have had a minimum of five years' experience in the exclusive practice of radiology or roentgenology. He must be a man of good standing in the medical profession, and particularly among those specializing in radiology. The director shall either be on a full-time basis or have definite hours of attendance at the department, such hours to be ample to insure the element of medical consultation in every examination or treatment.

The director shall have complete charge of the department, with responsibility for all examinations and treatments. He shall also be responsible for the employment of all professional assistants, and for the efficient maintenance of the department.

(*b*) *Assistants.*—The director may have a corps of qualified medical and technical assistants responsible to him, and for whom he is responsible, to carry out accurately the various functions of the department.

3. SCOPE

A department of radiology should be able to render all of the following services:

(*a*) Roentgenography, simple or stereoscopic, of any part of the body, with medical interpretation of the roentgenographic observations, and under satisfactory conditions for the protection of the patient and of the professional and technical personnel.

(*b*) Roentgenoscopy of any part of the body, in any position, with or without opaque mediums, with medical interpretation of the roentgenoscopic observations, and under satisfactory conditions for the protection of the patient and the professional and technical personnel.

(*c*) Roentgenotherapy of all benign and malignant diseases amenable to such treatment with roentgen rays generated at low, moderate or high voltage (long, medium or short wavelength), as the conditions may require, and under satisfactory conditions for the protection of the patient and of the professional and technical personnel.

(*d*) Radium therapy of all benign and malignant diseases amenable to such treatment with an adequate quantity of radium element or emanation, and under satisfactory conditions for the protection of the patient and of the professional and technical personnel.

Ultraviolet therapy, general or local, with satisfactory air-cooled and water-cooled quartz mercury lamps or carbon arc lamps, with suitable quartz and other applicators for irradiation of cavities, sinuses, or the superficial lesions under pressure, and under satisfactory conditions for the protection of the patient and of the professional or technical personnel. This stipulation is not mandatory, but the Council recommends that every department of radiology be equipped for ultraviolet therapy or that the ultraviolet equipment of hospitals be placed in the department of radiology. Ultraviolet treatment by the department of physical therapy shall not be countenanced unless such department is under the control and supervision of a medical director who has specialized in radiology.

A department of roentgenology should be able to render the services specified under *a*, *b*, and *c*.

A department of diagnostic roentgenology should be able to render the services specified under *a* and *b*.

A department of therapeutic roentgenology should be able to render the services specified under *c*.

A department of radium therapy should be able to render the services specified in *d*.

4. HOUSING

The housing should be adequate for the proper functioning of the department of radiology or roentgenology. Damp or ill ventilated quarters are unsuitable for such work.

5. EQUIPMENT

The equipment should be sufficient to carry out properly the technical procedures and activities of the department of radiology or roentgenology.

6. PROTECTION

The arrangement of working rooms and conditions, and the construction of all apparatus shall be such as to provide adequate protection, both from electrical shock and from avoidable exposure to roentgen rays or radium, to patients, attendants and other persons in or near the department. The requirements in this respect are based on the recommendations adopted by the International Congress of Radiology, held at Stockholm, Sweden, in July, 1928, and approved by the American Roentgen Ray Society and the Radiological Society of North America.

7. RECORDS

Full records of all examinations and treatments made by the department, suitably indexed, are essential. Roentgenograms made

in the department should have inerasible identification marks which will preclude error as to patients concerned. Roentgenograms may be lent to referring physicians but should be returned to the laboratory for filing and future reference. Suitable storage facilities should be provided where roentgenograms and other records will be both safe and readily available for reference. They shall be kept as long as there is the possibility of their being needed for the benefit of the patients or their physicians.

As roentgenography constitutes only a kind of medical examination, on which the roentgenologist's opinion of the patient's condition is partly or wholly based, and as the opinion of the specialist is the essential factor, the Council holds that the introduction of roentgenograms as evidence in medicolegal cases should be discouraged as immaterial and as tending to adulterate the process of justice. There is no more reason for the introduction of roentgenograms than for requiring a pathologist to bring to court his microscope and his sections of tissues.

8. REPORTS

The reports of an approved department of radiology or roentgenology shall be made through the director on stationery or blanks having the name of the director printed thereon. Under no circumstances shall roentgenologic diagnoses, interpretations, opinions, statements of prognosis, or therapeutic suggestions be offered by the nonmedical personnel.

9. LIBRARY

The department of radiology and roentgenology should be provided with, or have convenient access to, a library including current scientific books and journals on all the various subjects required in its work.

10. ETHICS, FEES AND PUBLICITY

Radiology is a special type of medical practice, and the physician practicing radiology is subject to the same rules of special training and conduct that govern his fellow specialists in the practice of medicine and surgery. The Principles of Medical Ethics of the American Medical Association shall apply in all cases. The fees charged for radiologic services shall be under the control of the director of the department. All systems of rebates, discounts, special group rates, etc., shall be considered unethical, except that, where the patient's economic status is the determining factor, the radiologist, like his fellow physician in medicine or surgery, may waive part or all of the fee.

The publicity of an approved department of radiology or roentgenology should be in professional good taste and limited to statements of fact as to name, address and telephone number; names and titles of the director and other active responsible personnel; field of work covered, office hours, directions for referring patients, and so forth. It should not contain misleading statements or claims of unusual superiority. It should not advocate medical fads nor lay undue stress on the importance of roentgenologic observations. On the letter heads or any other form of publicity, only the names of those rendering regular services to the department should appear as being connected with the department. Advertising matter should be directed only to physicians, either through bulletins or through recognized technical journals, and never to the nonprofessional public, as, for example, by announcements in popular journals and periodicals, circulars, pamphlets or telephone lists.

11. ADMISSION TO THE APPROVED LIST

Only those departments of radiology or roentgenology in which the personnel, space, equipment, management, finances and records are such as will insure honest, efficient and accurate work may expect to be listed as approved. Any department of radiology or roentgenology desiring to be placed on the approved list should apply to the Council on Medical Education and Hospitals of the American Medical Association, 535 North Dearborn Street, Chicago.

This schedule has been revised in accordance with suggestions received from the various members of the Council. In its preparation the Council has had the benefit of opinions and suggestions expressed by fifty or more individuals including many who are prominent in the field of radiology. Following its adoption, the Council will proceed to establish a list of approved radiologic laboratories in the same manner as it has developed its list of approved clinical laboratories.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Thirtieth annual meeting: Hotel Pennsylvania, New York City, Sept. 17–20, 1929.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Detroit, Mich., 1930.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Detroit, Mich., 1930.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Walter T. Bronson, Northwestern Univ. Med. School, Chicago, Ill.
Fifteenth annual session: New Royal York Hotel, Toronto, Canada, Dec. 2–6, 1929.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Lowell S. Goin, Wilshire Medical Building, Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting, Charlottesville, Va., Oct. 18, 1929.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Third session, Sydney, Sept. 2–7, 1929.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.

Meets annually.

Continental Europe

BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.

Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN

Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY

Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK

Secretary, Dr. O. Wissing, Copenhagen

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND

Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

JUDGMENT AGAINST DR. H. H. HAZEN REVERSED BY COURT OF APPEALS

On April 1, 1929, the Court of Appeals of the District of Columbia reversed a judgment of the Supreme Court of the District of Columbia against Dr. Henry H. Hazen of Washington, D. C.

Because of the importance of this

decision to every radiotherapist, the following report of the case is quoted from the *Washington Law Reporter* of April 26, 1929.

Court of Appeals of the District of Columbia

HENRY H. HAZEN, APPELLANT,
v.
MARGUERITE MULLEN, APPELLEE.

PHYSICIANS; X-RAY TREATMENTS; NEGLIGENCE.

1. It is the duty of a physician undertaking to treat a patient to exercise the ordinary care and skill of his profession, giving due consideration to modern advancement and learning; and there is an implied agreement that no injurious consequences will result from want of such proper skill, care and diligence.
2. One seeking to recover against a physician, alleging lack of skill or negligence, has the burden of proving his averments.
3. In an action against a physician for alleged negligence in subjecting plaintiff to exposure and to the influence of X-rays for an excessive length of time and too frequently, the evidence examined and held not reasonably to justify the conclusion that the defendant did not exercise his best judgment and ability in treating plaintiff, or that in his treatment of plaintiff he failed to exercise the care and skill ordinarily possessed and exercised by others in the profession; and a judgment for plaintiff reversed.
4. A case of malpractice can not be proven by the testimony of a few physicians or surgeons that they would have used some other treatment than the one used, in the absence of testimony from which it can be inferred that defendant failed to give to the case that skill and care ordinarily possessed and exercised by others in the profession.

No. 4724. Decided April 1, 1929.

Before Martin, Chief Justice, and Robb and Van Orsdel, Associate Justices.

APPEAL by defendant from a judgment of the Supreme Court of the District of Columbia, at Law, No. 68,243, entered upon a judgment for plaintiff in an action for malpractice in administering X-ray treatments. Reversed.

Mr. B. S. MINOR, Mr. H. P. GATLEY, Mr. A. P. DRURY and Mr. C. W. ARTH for the appellant.

Mr. T. M. WAMPLER for the appellee.

Mr. Justice ROBB delivered the opinion of the court:

Appeal from a judgment in the Supreme Court of the District in favor of the plaintiff in the sum of $15,000 in an action against the defendant and another for malpractice in administering X-ray treatments.

The declaration is in two counts, in the first of which it is alleged that the defendants "negligently and without reasonable skill or care, too frequently applied and used the said X-ray apparatus upon the plaintiff, and excessively exposed the plaintiff to X-ray treatments and to the influence and effect of the said X-ray." In the second count it is alleged that the defendants "negligently and carelessly subjected the plaintiff to exposure and to the influence of the said X-rays for an excessive length of time, and negligently and carelessly subjected the said plaintiff to exposure and to the influence of X-rays too frequently, and failed and neglected to use reasonable care and skill and ability in and about the treatment administered to the plaintiff."

In February of 1920 the plaintiff, Miss Mullen, consulted the defendant, Dr. Hazen. She was then suffering with a pronounced case of tubercular adenitis of the lymph nodes, a tubercular condition of the glands on both sides of the neck, running down to the middle of the clavicle and in the arm-pits. It clearly appears that she was in a serious condition and that unless relief was afforded her, very serious consequences might have resulted. As one physician testified, "In the absence of treatment the usual result in such a case is either a breakdown of the affected glands and a long continued discharge through open sinuses or rupture into the blood vessels with general dissemination of tuberculosis resulting ultimately in death." A surgical operation to remove the glands would have required an incision almost from the ear right down to the middle of the clavicle, with the complete cleaning out of everything in the neck on both sides, and in addition to that would have required operation in both arm-pits, and probably the operation would have extended from either the arm-pit up to the clavicle or from the clavicle down, or both, so as to get out the intervening glands.

As a result of the interview, Dr. Hazen undertook the treatment of Miss Mullen. These treatments, commencing in February, continued until sometime in November, 1920. One side of the neck would be exposed every other week. The treatments resulted in a complete cure.

Some time after the last treatment, the condition known as telangiectasis, or X-ray burn, appeared on plaintiff's neck, and it is of this she complains.

In 1923, after the appearance of the telangiectasis, plaintiff consulted a physician in New York, who gave her two radium treatments for the trouble.

Dr. Carr was the only physician to testify for the plaintiff. The doctor qualified as an X-ray specialist, and testified that while standard books on X-ray lay down rules with respect to the technique in the use of X-ray machines, "each man who is doing this work would probably arrive at his own personal technique." After explaining that the reddish-

ness, characterized as a recent sunburn, following exposure to the influence of the rays is called an X-ray erythema, the doctor was asked whether in his opinion a man possessing and exercising ordinary skill and ability in this particular line would reduce the length of exposure after the appearance of an erythema and while the erythema was still present and apparent, to which he replied that it would depend primarily on the degree of the erythema. A hypothetical question then was propounded to the doctor, based upon the assumption that plaintiff's evidence tended to show that exposures were continued every two weeks "after the appearance of the reddish glow characterized as a recent sunburn," and he was asked, "Would you say that the person I have described exercised ordinary skill and ability in treating that patient?" to which he replied, "I don't think he would."

Under cross-examination the witness stated that there are degrees of sunburn, and that "each man unquestionably develops certain differences, minor differences in treatment. I don't suppose any two men in the business do everything just the same. There are certain differences in the various text-books. The factors employed in the giving of X-ray treatments depend entirely upon what the treatment is given for. The treatment and dosage and distance and duration of treatment in the case of tubercular adenitis would be different from many other troubles. I know of X-ray treatments being given where there has been an erythema . . . That is largely a question of judgment on the part of the person giving the treatment . . . Whether they would give a subsequent treatment or not would depend upon the man's judgment, of course, upon the exercise of judgment upon his part; regardless of technique, the erythema following a dose of X-ray probably is the one more or less constant factor that controls the man's subsequent dosage, and that of course does depend on his judgment, and that is the only way it can be determined. It is a matter of judgment in the light of the skill possessed by the man who is giving the treatment. I do not know anything about the treatment in this case."

It was "conceded and agreed by both parties that at the time of the treatment of the plaintiff by the defendants, the defendants were possessed of the degree of skill and ability in their particular line of work possessed by men of that class in Washington, ordinary degree of skill and ability."

Dr. Carr, as well as the expert witnesses for the defendant, agreed that X-ray treatment was the recognized treatment for tubercular glands.

Several physicians who qualified as expert X-ray practitioners testified for the defendants that telangiectasis "may follow X-ray treatment notwithstanding the fact that the highest degree of skill and care has been exercised in the giving of such treatment," and that there is no method known to the medical profession of foretelling whether or not telangiectasis may follow such treatment. This testimony was not met by the plaintiff. These witnesses agreed that the treatments administered to plaintiff as shown by the record kept by Dr. Hazen were proper and in accordance with the best knowledge and skill possessed by men engaged in X-ray work in the District at the time.

Dr. Hazen received his bachelor's degree at Johns Hopkins in 1902, and the degree of doctor of medicine at the same institution in 1906; had been connected with Freedmen's, Georgetown, Columbia and Gallinger Hospitals; and received an honorary Master's degree from Georgetown. He had specialized in skin diseases, particularly X-ray in relation to skin diseases. Had been a contributor to medical works on X-ray treatments, and had specialized in X-ray work since 1909 continuously. Before graduating from the medical school he spent a year in the tuberculosis dispensary, and after graduating spent two years in the tuberculosis dispensary of Johns Hopkins.

In Clayton v. English, 57 App. D. C., 324, 23 F. (2d), 745, 56 Wash Law Rep., 6, a malpractice case, we said that it is the duty of a physician in undertaking to treat a patient to exercise the ordinary care and skill of his profession, giving due consideration to modern advancement and learning, and that there is an implied agreement that no injurious consequences will result from want of such proper skill, care and diligence; that one who seeks to recover against a physician, alleging lack of skill or negligence, has the burden of proving his averments. In the Cayton case we quoted from the opinion of Judge Taft, now Chief Justice of the United States, in a malpractice case (Ewing v. Goode, 78 F., 442), in which he said: "Before the plaintiff can recover she must show by affirmative evidence—first, that defendant was unskillful or negligent; and, second, that this want of skill or care caused injury to the plaintiff. If either element is lacking in her proof, she has presented no case for the consideration of the jury. The naked facts that defendant performed operations upon her eye, and that pain followed, and that subsequently the eye was in such a bad condition that it had to be extracted, establish neither the neglect and unskillfulness of the treatment, nor the causal connection between it and the unfortunate event."

In the present case it is admitted that Dr. Hazen possessed requisite skill, so that the only question is whether he was guilty of negligence in his treatment of plaintiff, or, in the words of the declaration, whether he "negligently and carelessly subjected the plaintiff to exposure and to the influence of the said X-rays for an excessive length of time, and negligently and carelessly subjected the said plaintiff to exposure and to the influence of X-rays too frequently." In our view, there is no evidence in this record reasonably justifying such a conclusion. When Miss Mullen consulted Dr. Hazen she was in a very serious condition, and the doctor was bound to take the seriousness of her condition into consideration in determining the course of treatment to be given her. Dr. Carr, plaintiff's only expert witness, frankly stated that the frequency of X-ray exposures would depend upon the judgment of the physician administering them; "regardless of technique, the erythema following a dose of X-ray probably is the one more or less constant factor that controls the man's subsequent dosage, and that of course does depend upon his judgment, and that is the only way it can be determined." While Dr. Carr, in answer to a hypothetical question, expressed the opinion that the treatment accorded plaintiff was improper, it is perfectly apparent from his other testimony that physicians equally skilled, in the exercise of their best judgment, might have administered the same treatment which was given by Dr. Hazen. In other words, Dr. Carr admits that it is a question for the exercise of the judgment of the particular physician in the light of existing conditions, and that Dr. Carr's judgment differs from that of Dr. Hazen and his expert witnesses.

"A case of malpractice can not be proven by the testimony of a few physicians or surgeons that they would have used some other treatment than the one used, in the absence of testimony from which it can be inferred that the defendant failed to give to the case that skill and care ordinarily possessed and exercised by others in the professions." Gramaldi v. Zeglio, (N. J., Sup.), 129 Atl., 475. See also Williams v. Poppleton, 3 Ore., 139; MacKenzie v. Carman, 103 App. Div., 246, 92 N. Y. Sup., 1063.

It is conceded that Dr. Hazen possessed the requisite degree of skill and ability; that X-ray treatment was the recognized treatment for tubercular glands; it clearly appears that the length of time between exposures of the same area depends upon existing conditions and the judgment of the operator; that telangiectasis may occur even if the highest skill is exercised in the treatment. As already observed, there is no evidence upon which it reasonably may be found that Dr. Hazen did not exercise his best judgment and ability in treating the plaintiff, or that in his treatment of the plaintiff he failed to exercise the care and skill ordinarily possessed and exercised by others in the profession.

The judgment is reversed, with costs, and the cause remanded. Reversed.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the annual meeting of the New England Roentgen Ray Society, Dr. John H. Lambert, of Lowell, was elected President for the ensuing year, Dr. A. S. MacMillan, of Boston, Vice-President, and Dr. Thomas R. Healy, of 370 Marlboro Street, Boston, Secretary and Treasurer. The retiring President, Dr. Frank W. Lamb, was added to the Executive Committee.

PRELIMINARY PROGRAM OF THE THIRTIETH ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY, SEPTEMBER 17–20, 1929, HOTEL PENNSYLVANIA, NEW YORK CITY

TUESDAY MORNING, SEPT. 17, 1929

HEART SYMPOSIUM

Title of paper to be announced later. George W. Holmes, M.D., Boston, Mass.

Roentgenological and Anatomical Studies on the Aorta. David S. Dann, M.D., Kansas City, Mo.

Standard Left Oblique Study of the Heart and Great Vessels with Tables of Cardiac Area and Valve Measurements. Stafford L. Warren, M.D., Rochester, N. Y.

Roentgenological and Pathological Findings in Some of the Valvular Lesions. David S. Steel, M.D., Cleveland, Ohio.

Luetic Aortitis. Aubrey O. Hampton, M.D., and T. Duckett Jones, M.D., Boston, Mass.

Roentgen Examination of the Heart in Relation to the Clinical Findings. Paul D. White, M.D., Boston, Mass.

TUESDAY AFTERNOON, SEPT. 17, 1929

Xanthomatosis ("Defects in Membranous Bones, Exophthalmos and Diabetes Insipidus"). M. C. Sosman, M.D., Boston, Mass.

Indirect Signs of Brain Tumor as Noted in Routine Roentgen Examination. (A Survey of 3,000 Consecutive Skull Examinations.)

A. Intracranial Pressure. B. Displacement of Pineal Shadow. C. G. Dyke, M.D., and W. F. Schreiber, M.D., Boston, Mass.

Hemolytic Anemias. G. C. Vogt, M.D., and L. K. Diamond, M.D., Boston, Mass.
Experimental Acromegaly. Tracy J. Putman, M. D., Boston, Mass.
Calcifications in Skull and Roentgenologic Significance. John D. Camp, M.D., Rochester, Minn.
Value of Roentgenologic Examinations of the Accessory Nasal Sinuses. George W. Grier, M.D., Pittsburgh, Pa.

TUESDAY EVENING, SEPT. 17, 1929

Intraspinal Iodolography,—Roentgen Determination of Intraspinal Lesions with the aid of Iodized Oil. Leopold Jaches, M.D., and Joseph H. Globus, M.D., New York City.

LANTERN SLIDES

Anyone who wishes to show lantern slides at this meeting should communicate with Dr. Webster W. Belden, New York Hospital, New York City, previous to the time of meeting.

WEDNESDAY MORNING, SEPT. 18, 1929

SYMPOSIUM

Title of paper to be announced later. R. B. Greenough, M.D., Boston, Mass.
Results in a Series of Cases Treated After Five Years. Wm. A. Evans, M.D., Detroit, Mich.
The Roentgen Treatment of Pelvic and Vertebral Metastases from Cancer of the Breast. E. T. Leddy, M.D., Rochester, Minn.
Surgical View of Cancer of the Breast. G. H. Semken, M.D., New York City.
Discussion: G. E. Pfahler, M.D., Philadelphia, Pa., and U. V. Portmann, M.D., Cleveland, Ohio.
Treatment of Exophthalmic Goiter and Hyperthyroidism by means of Roentgen Rays, with a Statistical Analysis of 500 Cases. G. E. Pfahler, M.D., and Jacob Vastine, M.D., Philadelphia, Pa.
Radiation Therapy in the Treatment of Menstrual Headaches. Charles L. Martin, M.D., Dallas, Texas.

WEDNESDAY AFTERNOON, SEPT. 18, 1929

Deforming Bone Diseases of Adolescence. Alfred L. Gray, M.D., Richmond, Va.
Roentgenological Diagnosis of Rickets. Ralph S. Bromer, M.D., Philadelphia, Pa.
Bone Lesions of Congenital Syphilis. Stafford McLean, M.D., New York City.
Discussion by E. A. Park, M.D., Baltimore, Md.
Disease of the Upper Respiratory Tract. H. K. Pancoast, M.D., and E. P. Pendergrass, M.D., Philadelphia, Pa.
Discussion by Chevalier Jackson, M.D., Philadelphia, Pa.
Tuberculous Mediastinitis. Karl Kornblum, M.D., and David Cooper, M.D., Philadelphia, Pa.
Discussion by E. L. Opie, M.D., Philadelphia, Pa.
Clinically Manifest and Latent Tuberculosis. E. L. Opie, M.D., Philadelphia, Pa.
Anatomic Interpretation of Roentgenologic Findings in Pulmonary Tuberculosis, With Reference to the Scientific Exhibit. Wm. A. Evans, M.D., and Max Pinnar, M.D., Detroit, Mich.

WEDNESDAY EVENING, SEPT. 18, 1929

Ulcer of the Esophagus. Chevalier Jackson, M.D., Philadelphia, Pa.
Caldwell Lecture. "Teaching in Roentgenology." Frederick H. Baetjer, M.D., Baltimore, Md.

THURSDAY MORNING, SEPT. 19, 1929

Clinic by Dr. Leopold Jaches and Dr. Coleman B. Rabin on "Correlation of Pathological and Roentgen Findings of Lung Tumors" will be given at Mount Sinai Hospital.
Clinic dealing with "Diagnosis and Therapy of Malignant disease" will be given by staff at Memorial Hospital.
The New Medical Center invites the members of the society and its guests to visit it. The roentgen department will be thrown open for inspection and clinics will be given by various members of the hospital staff on subjects pertaining to the value of roentgen diagnosis.
Dr. Lewis Gregory Cole will give at the Fifth Avenue Hospital the premier demonstration of a roentgen cinematographic apparatus as a memorial to Joseph Purcell by his wife, Annie Purcell. This apparatus is the latest development of an attempt to make roentgenograms on a roll film sufficiently rapid to demonstrate the actual movements of the stomach, small intestine, and colon. The original attempt of the author to do this was demonstrated before the American Roentgen Ray Society in Detroit in 1910. A full description of the apparatus will appear in an early issue of the American Journal of Roentgenology and Radium Therapy.
Since the accommodations at the various hospitals are limited, tickets of admission will be issued and must be secured at the time of registration.

THURSDAY AFTERNOON, SEPT. 19, 1929

Intrathoracic Tumors. B. R. Kirklin, M.D., Rochester, Minn.
Various Types of Metastasis of the Lungs. P. M. Hickey, M.D., Ann Arbor, Mich.
Interlobar Effusions. Isaac Gerber, M.D., Providence, R. I.
Report of the Committee for the Study and Correlation of Data to Be Used in the Standardization of the Technique and Interpretation of Encephalography. Henry Pancoast, M.D., Philadelphia, Pa.
Address on "Some Properties of X-ray Energy Quantum." Dr. Bergen Davis, Department of Physics, Columbia University, New York City.

THURSDAY EVENING, SEPT. 19, 1929

BANQUET

FRIDAY MORNING, SEPT. 20, 1929

Marble Bones. A. H. Pirie, M.D., Montreal, Canada.
Myoma of Bone. John T. Murphy, M.D., Toledo, Ohio.
Gastric Retention. A. B. Moore, M.D., Rochester, Minn.
Cecal Stasis. J. L. Kantor, M.D., Samuel Schechter, M.D., and Jerome A. Marks, M.D., New York City.
Clinical, Roentgen-Ray, and Operative Findings—Case of Papilloma of the Colon. Wm. H. Stewart, M.D., New York City.
Further Study of Technique of Intravascular Administration of Tetraiodophenolphthalein. Charles Waters, M.D., Baltimore, Md.

FRIDAY AFTERNOON, SEPT. 20, 1929

Review of Some of the Early Books on Electricity. Edward H. Skinner, M.D., Kansas City, Mo.
Development of Roentgenograms. Adjustment of Fixed Time Development to Weakening of Developer with Use. R. R. Newell, M.D., and W. E. Chamberlain, M.D., San Francisco, Calif.
Special Report of the Safety Committee.

A Clinical Evaluation of Radium and Roentgen Radiation on Basis of Variable Combinations of Wave Lengths. B. P. Widmann, M.D., and J. L. Weatherwax, Philadelphia, Pa.

Simple Type of Radiometer. R. B. Taft, M.D., Charleston, S. C.

The Effect of Roentgen Rays on the Reticulo-endothelial System. Ernst A. Pohle, M.D., Madison, Wis.

THE UNITED STATES VETERANS' BUREAU NEEDS PHYSICIANS

Anticipating the need of physicians for the future, the U. S. Veterans' Bureau proposes placing on duty at its several hospitals throughout the United States thirty additional physicians as soon as they can be secured. These physicians must meet the requirements of the Civil Service Commission as to training and experience; in general, it may be stated that they must have graduated from a Class A medical school within five years of date of application and, in addition, must have had at least one year's internship in a general hospital.

Physicians who have training and experience in such specialties as neuropsychiatry, operative surgery, eye, ear, nose and throat diseases, and clinical pathology, are particularly urged to forward their applications to the U. S. Civil Service Commission, 1724 F Street, N. W., Washington, D. C., and request that the necessary forms be sent them for execution.

The Medical Service of the Bureau offers a diversified and interesting service for physicians, with opportunities for research, post graduate training, etc. The entrance salary is $3200 per annum, and, if the service of the medical officer is satisfactory, he may be promoted in increments of $200 per annum, and, upon the completion of three years of satisfactory service, he will be automatically promoted to the next higher grade at the minimum salary of that grade,—$3800 per annum.

MERGER OF INTEREST TO ROENTGENOLOGISTS

The merger of the Acme-International X-Ray Company of Chicago and the Engeln Electric Company of Cleveland, to be known as the American X-Ray Corporation, has just been announced, effective July 1, 1929. Both of these companies have for many years played a conspicuous rôle in the development of X-ray and physical therapy apparatus, and have won a vast number of friends in the medical profession throughout the country.

Leonard A. Busby, president of the Chicago City Railways, was elected president of the American X-Ray Corporation. The officials who have in the past guided the two companies remain actively in charge of its management; H. P. Engeln, first vice-president in charge of sales; Frank L. Severance, vice-president and general manager; and Montford Morrison, vice-president and chief engineer.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY & RADIUM THERAPY *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

Vol. XXII, No. 2

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A REVOLVING FILTER FOR USE IN ROENTGEN THERAPY

BY LEONARD JONES RAVENEL, M.D.

FLORENCE, SOUTH CAROLINA

DISCOURAGEMENT attending roentgen treatment, particularly of that large group of lesions commonly encountered situated at or near the surface of the body and susceptible of attack with the rays through a single port of entry, led me to make an intensive study of ways by which results might be improved upon, culminating in the production of the apparatus herein described which has been in daily use in my laboratory for the past three years.

The filter element as shown (Fig. 1) is formed of circular plates of aluminum, each 1.0 mm. in thickness, cut in such manner that when superimposed in correct relation a series of "wedges" are produced having the following proportions:

1 mm. thick.....	$\frac{1}{24}$ of the total area.
2 mm. thick.....	$\frac{1}{12}$ of the total area.
3 mm. thick.....	$\frac{1}{8}$ of the total area.
4 mm. thick.....	$\frac{1}{4}$ of the total area.
5 mm. thick.....	$\frac{1}{2}$ of the total area.

The thickness of the minimum "wedge" and thereby the thickness of the others may be increased by the addition of any number of uncut 1.0 mm. plates desired.

When assembled the filter is revolved within the fixed frame, which is attached about the aperture of the holder beneath the tube, by means of a gear train operated by a small motor deriving its current supply from a 110 volt source (Fig. 2). While the rate of rotation is relatively unimportant in practice, by means of the gearing ratios and a governing principle connected with the motor, about seven complete turns occur per minute. There is no appreciable noise or vibration. The apparatus has been constructed to conform to a No. 8 Victor tube stand but could easily be made adaptable to other makes or types.

The device was developed upon the basis of factors involved in the following major hypotheses which I felt justified in establishing from known facts, personal experiments, and observation:

a. The intensity of radiation at a given point from the source varies inversely as the square of the distance.

b. The effect of radiation upon tissue is in direct proportion to the amount of radiation absorbed within it.

c. The degree of penetration of a radiation is dependent upon its wave length, the longer the wave length the more readily arrested, and vice versa.

d. An individual "ray" or vibration follows such physical characteristics at all times as its quality engenders, particularly relating to the depth to which it may go in tissue before being stopped.

e. Within given periods of time the proportionate amount of biological effect of the so-called "secondary" radiation set up by the passage of an original or "primary" beam is much in minority as compared with the effect attending absorption of the latter.

f. In any roentgen spectrum, regardless of the potential at which it is generated or produced, vibrations having longer wave lengths are in quantitative preponderance.

g. As filtration is increased the individual vibrations emitted by the filter become progressively restricted in such manner that they eventually reach a state of unification in the qualitative sense.

h. Photographic or ionization measurements of intensity in the depths cannot

be translated equally in terms of tissue change.

From an analysis of the foregoing postulates, it appeared that were it

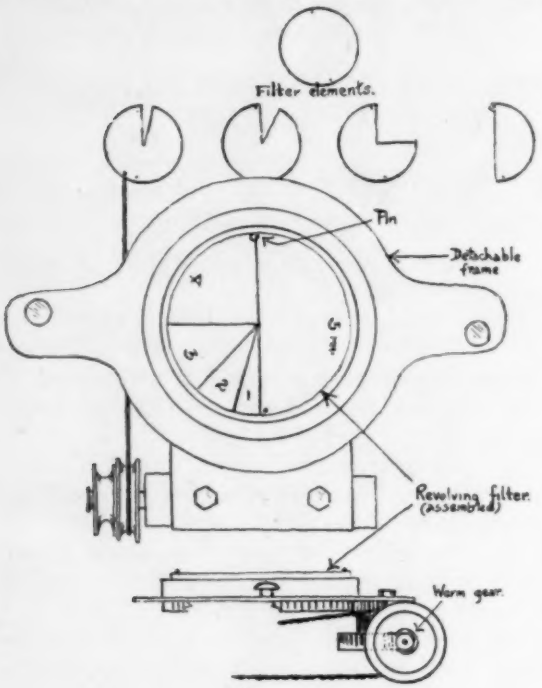

FIG. 1.

possible to produce a spectrum containing a certain definite quantitative relation between the numerous qualitative increments of the "beam", an absorption curve would ensue within the structure under treatment of such form that the *biological* effects would closely approach homogeneity throughout a depth and width of field.

It is obvious that the employment of a fixed metallic plate as a filter, of a standard thickness throughout its area, does not permit of alteration of the transmitted vibrations beyond exclusion of the longer elements.

By means of a revolving filter such as I have described, incorporating, as it does, successive "wedges" of metal of different thickness and area, it seems entirely feasible to deliver a spectrum, the varied qualitative components of which are so distributed in point of quantitative ratio as to compensate by absorption factors (and hence cellular reaction) for the loss in intensity by divergence as succesive layers are traversed, within defined limits.

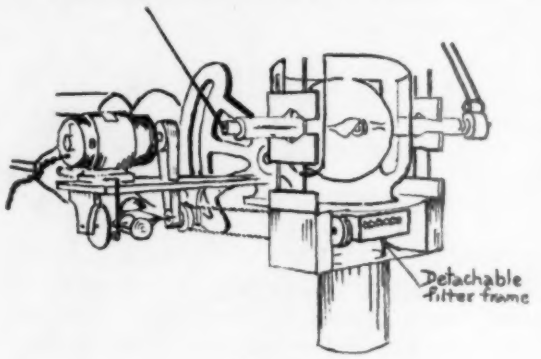

FIG. 2.

Clinical deductions attending the use of the filter have justified in large measure the expectation of enhanced results. By utilizing a fixed focal skin distance and by increasing or decreasing the thickness of the minimum area of "wedge," the plates can readily be changed to conform to the treatment of conditions which bring into play varying physical factors, particularly those having to do with the distance of a lesion beneath the body surface. Certain principles have been established for use in this connection, and charts have been formulated, based upon arithmetical computation and checked by clinical observation, showing the exposure time necessary for the production of skin erythema for the kilovoltages and milliamperages used in practice, as applied to numerous combinations of filter elements and a fixed distance from target to surface.

I may say that the technique for even superficial lesions employs a lower voltage than that commonly advocated, and relatively heavier filtration, necessitating longer exposures than ordinarily employed.

This brief outline of the device is presented that others may be stimulated to an investigation of the practical utility of the apparatus, which doubtless is susceptible of further elaboration.

Vol. XXII, No. 2

AN APPARATUS FOR VISIBLY MARKING DENTAL ROENTGEN FILMS

BY HUGH J. HOPKINS, M.D.

DENVER, COLORADO

BY the use of the apparatus here described dental roentgen films can be visibly marked by a very simple procedure. This is especially useful when the negatives are to be viewed immediately after developing. In such cases the negatives are still wet and determination of their relative positions in the mouth is somewhat annoying and at times uncertain. By this method such undesirable features are entirely eliminated. No figuring as to the position of the negative is necessary because the location is plainly and unmistakably marked in the negative itself immediately after exposure.

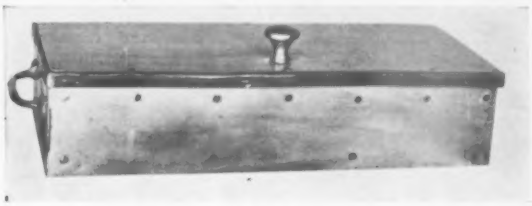

Fig. 1.

Fig. 2.

being accidentally exposed to the rays. The lettering of the negatives is accomplished by means of stencils cut in the lead covering of the lid through which the roentgen rays pass during the process of marking. The stage with four films upon it with lid raised is shown in Figure 2. A above the "stage" upon which the films are placed after exposure and before marking. In the rest of the box the unexposed film is kept and is in no danger of

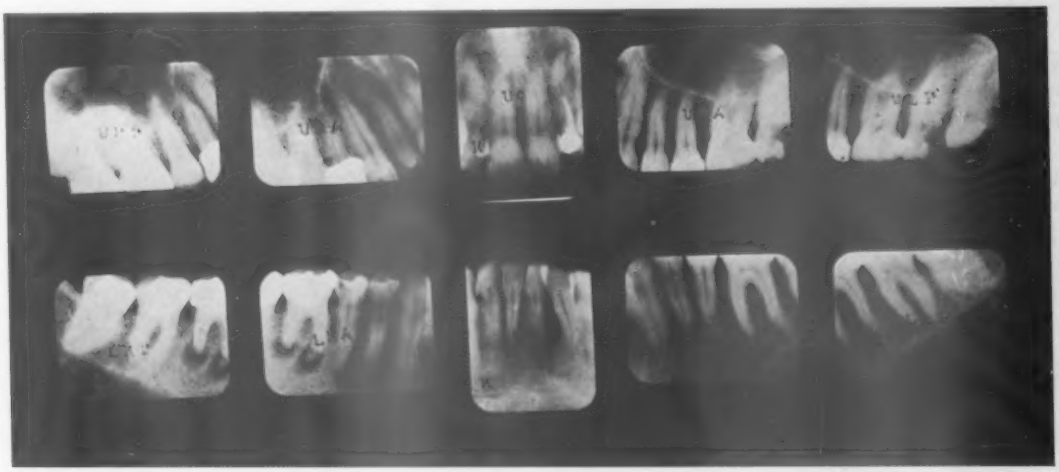

Fig. 3.

DESCRIPTION

The apparatus consists of a lead-covered box as shown in Figure 1. The lid is hinged and when lowered is immediately

complete set of lettered negatives is shown in Figure 3. The meaning of the letters is as follows: "U" upper, "L" lower and also left, "R" right, "A" anterior, and "P" posterior. The stenciled letters in the lid cannot be seen in Figures 1 and 2 because of a superficial layer of aluminum.

TECHNIQUE

1. Raise the lid and procure an unexposed film from the left end of the box. Lower the lid and place the film in the mouth of the patient and expose in the usual manner.

2. Raise the lid and place the exposed film in the square on the stage which corresponds to the position of the film in the mouth of the patient during exposure. Procure another unexposed film from the left end of the box and lower the lid. Repeat this process until all necessary films have been exposed and placed in their proper positions on the stage.

3. Place the box with the lid lowered on a horizontal surface 24 to 30 inches directly below the roentgen tube. Now expose the entire box in this position, with the lid lowered, to the rays for five to ten seconds depending upon the amount of kilovoltage and milliamperage used. The films are now lettered and may be removed from the stage and developed, no care being taken to prevent mixing.

RESULTS

Lettering on the negatives is plainly visible and exact. It is easily accomplished and has not been found to interfere with the image in any way. A very convenient storage place for unexposed film is also provided. Disorientation of films before lettering is highly improbable and after lettering—impossible.

THE LATERAL TRANSTHORACIC ROENTGENOGRAM AS A DIAGNOSTIC AID IN FRACTURES OF THE UPPER END OF THE HUMERUS

BY CARL W. COHOON, M.D.*

PHILADELPHIA, PENNSYLVANIA

THE ideal examination of any fracture includes two views made at right angles to each other. In fractures and dislocations of the upper end of the humerus, the roentgenologist is handicapped in making the usual views because of the anatomical relation, surgical dressings or pain caused by manipulation. We have had to depend largely on stereoscopic views for interpretation of injuries of the upper end of the humerus. This is a satisfactory method, but it does have the following limitations: in teaching students in a clinic; in assuring a surgeon of the position of the fragments if the surgeon is unfamiliar with stereoscopy, or one who has a physical limitation which prevents the use of the stereoscope.

The following technique of making lateral transthoracic roentgenograms of the upper end of the humerus for fractures or dislocations is presented. It is an additional diagnostic procedure to the usual stereoscopic examination and has been found to be of considerable value.

The patient is seated in the erect posture on a stool with the injured part either in the usual carrying position or in the position in which it has been dressed (see Fig. 1). If the arm and forearm are dressed in the so-called aeroplane splints with the upper extremity at right angles to the body, this examination is not applicable. The hand of the unaffected arm is put on top of the head. A cassette containing a film and double intensifying screens is placed in contact with the lateral aspect of the upper end of the injured humerus. A Coolidge tube mounted on a movable stand is then so placed that the central ray traverses the thorax laterally

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and in a slightly upward direction to fall at right angles on the center of the film. A skin target distance of 15 inches, combined with the use of a metal cone 6 inches long and outlet of 5 inches has been found satisfactory. This arrangement allows a target cassette distance of 36 to 40 inches, depending upon the thoracic development of the patient. A 5½ inch spark gap and 20 ma. current are the physical factors which permit an adequate exposure for the average individual in 4½ seconds.

Fig. 1. Position for lateral transthoracic roentgenogram of the upper end of the humerus. Central ray is projected at right angle to film.

In this transthoracic method of securing lateral roentgenograms, scattering of the primary beam and secondary radiation from the thoracic tissues combine to obscure fine skeletal detail, but this has not been found to interfere unduly with securing films of sufficient definition for accurate fragment localization in the anteroposterior direction in fractures of the upper end of the humerus (see Figs. 2 and 3).

Fig. 2. Fracture of upper end of left humerus; anteroposterior view.

Fig. 3. Lateral transthoracic view of same case showing slight degree of apposition of fragments and anterior displacement of lower fragment.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Artner, Hans. The post-appendectomy stage in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 609–615.

The author recently observed the appearance of typical ring shadows in the region of the appendicial stump in cases following appendectomy. A systematic study carried out in all cases arriving for gastrointestinal examination in which appendectomy had been performed revealed that in one-third of the cases peculiar shadows appeared in the region of the appendicial stump, 8 per cent of which were typical ring formations. From anatomico-pathological sections in patients who died, the conclusion was reached that these shadows are the result of various stump formations due to different sutures applied at the time of operation. The circular suture with invagination of the stump results in typical ring formations, while the z and the transverse sutures lead to shadows of irregular shape and character.

It is interesting that in some instances barium may form a residue in the stump for a period of several days.—*T. Leucutia.*

Belot, J., and Pasteau, O. The present state of roentgenologic explorations in the diagnosis of renal affections. *J. de radiol. et d'électrol.*, March, 1929, xiii, 129–198.

In this interesting article the authors give a very detailed description of the present methods used for the roentgenologic exploration of renal affections. After a review of the more salient points of the medical literature, in the first part of the paper the procedure of examination and technique of exposure are considered, while in the second part the anatomical and pathological conditions of the kidneys as well as the various phases of differential diagnosis are discussed. It is impossible to give an adequate abstract of this detailed article. Seventy-five beautiful cuts are used for illustrations.—*T. Leucutia.*

Bernstein, Arnold. The study of normal and pathological peristalsis of the stomach with the aid of polygraphy. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 598–608.

Three methods are of especial importance in the roentgenologic examination of the stomach: roentgenoscopy, roentgen cinematography and polygraphy. The value of roentgenoscopy and roentgen cinematography is now generally admitted. Polygraphy, however, has received only limited application, although the first essays date back as far as 1910 (Bachem and Günther).

The author reapplied the method in about 50 cases and found that polygraphy is of considerable diagnostic aid, especially in the localization of ulcers.

The method consists in making 2, 3 to 4 (best 3—triplogram) exposures in rapid succession (3 to 5 sec. intervals) on the same film. It is essential that the patient be kept absolutely still till all exposures are completed and that the exposures be as light as possible so as not to produce a too intensive darkening of the film. The advantage of polygraphy over cinematography is that the method can be used also in recumbent position.

After describing one case in detail, the author analyzes in how far polygraphy can be used for the confirmation of Frankel's roentgen cinematographic signs of gastric ulcer ("bolt" formation, basilisk appearance and preperistalsis). It was found that the arrest in motion in the area around the ulcer giving the impression as though a bolt had been put in that place, can be very well demonstrated by means of polygraphy. In the instance described this bolt formation which extended to the lesser curvature, was the only sign suggestive of ulcer, and a check-up examination in different views later revealed the site of the ulcer on the posterior wall and at a distance of several centimeters lateral to the area of bolt formation on the lesser curvature. One may expect that the method can be used also for the demonstration of other cinematographic signs of gastric ulcer (basilisk appearance and preperistalsis).—*T. Leucutia.*

Bowman, W. B., and Goin, L. S. Obscure kidney lesions. *Radiology*, March, 1929, xii, 188–192.

The authors report several cases of nephroptosis with kinking of the ureter, renal calculi and renal tumor, all with obscure symptoms. They suggest (1) that in all cases with unexplained abdominal pain a complete genito-urinary examination, including roentgenograms before and after injecting the kidney and ureter, be made, and (2) that, when indicated, the examination should include pyelograms with the patient in an upright position. Only

by the latter method were the cases of renal ptosis with ureteral kinking which they report demonstrable.—*J. D. Camp.*

Braasch, W. F. Roentgenologic diagnosis of ureteral stricture. *Radiology*, March, 1929, xii, 183–187.

Although urography offers the best method of determining the existence of ureteral stricture, Braasch observes that there are many factors which lessen the accuracy of this procedure. This is particularly true when the ureteral dilatation above the obstruction is moderate or confined to the area immediately adjacent to the stenosis. To add to the confusion, the outline o' the normal ureter varies considerably. While it is well known that in most normal ureters there are three areas of relative narrowing, this is not constant and the caliber varies in different portions. Added to this is the difficulty of uniform distention. Over-distention in one part with incomplete filling adjacent to it might easily give the impression of dilatation. Return flow alongside the catheter is difficult to overcome, and as a result areas of apparent constriction may disappear when a second roentgenogram is made with more complete distention. With so many factors involved, an unqualified diagnosis may be impossible.—*J. D. Camp.*

Brednow, W. The suitability of umbrathor in pyelography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 684–687.

Although umbrathor produces excellent contrast in pyelography, in one case a blockage of both ureters occurred due to precipitation of the umbrathor, resulting in anuria. The condition was relieved by careful washing of the ureters. The case is described in detail.

The conclusion is reached that umbrathor is not suited for pyelography and that its application may result in serious injuries.—*T. Leucutia.*

Chizzola, Giuliano. The roentgen study of the cecal appendix. *Radiol. med.*, Jan., 1929, xvi, 36–63.

The series includes 353 examinations in the living (76 of which were confirmed at operation) and 108 post-mortem examinations.

The procedure of the roentgen examination was as follows: The usual barium meal was given and films were taken at intervals of four, six, eight, twenty-four, thirty-two, forty-eight hours and several days. Six hours after the first meal a second meal was given of the same amount and composition according to Haudek's indication so as to produce a longer sojourn of the opaque meal in the cecum and consequently a better filling of the appendix. During the past year sulphate of magnesium according to Czepa has also been used.

In a first group of cases (159) without any preliminary preparation the appendix was visualized in 40.8 per cent of the cases; in a second group (122 cases) with careful preliminary preparation (emptying of the intestine, especially cecum) the appendix was visualized in 61.2 per cent of the cases, and in a third group of cases (72) in which magnesium sulphate had been administered the appendix was visible in 56 per cent of the cases. An additional examination by means of barium enema, as well as the compression of the cecum during the examination so as to force the opaque medium into the appendix, failed to increase the percentage of visualized appendices.

The filling of the appendix may be total or partial, occurring as a rule within eight to twenty-four hours following the ingestion of the barium meal. A hastier or a retarded filling does not necessarily mean a pathological condition.

From the roentgenologic standpoint a certain importance must be given to the length, size, segmentation and attachment of the appendix. Topographically we may distinguish between ascending, descending and lateral type. A non-filling of the appendix does not necessarily mean a normal appendix. Anatomists agree that in 3 to 4.5 per cent there is a total obliteration of the appendix and that the percentage of partial obliteration may reach a figure as high as from 25 to 50 per cent.

The roentgenologic signs of chronic appendicitis are: (1) Physical signs: pain, irregular filling, recoiling, presence of foreign bodies and fixation. (2) Functional signs: delayed evacuation of the appendix, hypermotility and spastic contractions. (3) Extra-appendicular signs: biliary or duodenal spasm, ileocecal stasis, periduodenitis, pericholecystitis, etc.

It is recommended that the roentgen diagnosis of a pathological appendix always be based on the coexistence of several signs and if possible on coordination with the clinical findings.—*T. Leucutia.*

Cole, Lewis Gregory. Malignancy of gastric ulcer. *Radiology*, January, 1929, xii, 48–57.

A summary of 10 cases indicates that in those cases where it is difficult to make a differential diagnosis between malignancy and non-malignancy on the basis of the roentgen findings, it is equally difficult to make a differential diagnosis on the surgical exploration.

In all of the cases observed by Cole, both prior to his original communication in 1920, and for seven years since, he has seen only one

case in which a positive diagnosis of benign ulcer was justified by repeated roentgenographic examinations, and in which the patient subsequently developed carcinoma and died of it.

The author believes that the procedure of watching the ulcer diminish in size during a period of rest in bed, enables one to make a differentiation between malignancy and nonmalignancy with as great a degree of certainty as can be done by microscopic examination of the pathological section after its removal.—*J. D. Camp.*

Erdélyi, Josef. Differential roentgen diagnosis in carcinoma of the lung. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 619–624.

It is advised that films be taken with roentgen rays of various hardness in order to permit better differentiation of the tumor structures. In some instances the use of pneumothorax is of considerable aid.—*T. Leucutia.*

Feci, Lorenzo. Contribution to the roentgenologic diagnosis of benign tumors of the stomach. *Radiol. med.*, Jan., 1929, xvi, 1–16.

After a short review of the literature dealing with the roentgen diagnosis of benign tumors of the stomach, the author describes 2 cases of his own (one a large polyp at the outlet of the stomach, and the second a polyp of the antrum) in which correct diagnosis was made by means of roentgen examination. The roentgenograms as well as the operative specimens are presented.

In connection with this, the author discusses the frequency of the different types of benign tumors (polyp, lipoma, myoma, fibroma, etc.) of the stomach and after an analysis of the clinical symptoms gives the following roentgenologic signs as more or less characteristic: rounded or oval filling defect with sharp regular outline (situated in the majority of the cases centrally or less frequently excentrically but never marginal, there being occasionally a reticulated aspect of the defect); normal appearance of the folding of the mucous membrane around the filling defect and normal appearance of the stomach as a whole, especially as regards its form, volume, contour and peristalsis. If the tumor is located near the outlet of the stomach as, for example, in the first case, there may be a considerable delay in emptying of the stomach.—*T. Leucutia.*

Forestier, J. Actual technic of examination of the spinal cavities with lipiodol. *Radiology*, 1928, xi, 481–489.

The best technique for the lipiodol test of the spinal subarachnoid space is the roentgenoscopic technique. This examination can be performed after lumbar injection of lipiodol, the patient being put in the head-down position on a tilting roentgenologic table. Roentgenograms should be taken in the course of the roentgenoscopic examination, when definite abnormality of the transit is noticed. The position of the patient should not be changed for the taking of the roentgenograms.

When there is a total block of the subarachnoid space, the examination gives a suggestive result. The lipiodol globule first begins its normal course, and then, at a definite level, the elongated ball becomes deformed into a large opaque mass with a transverse or curved lower border.

Intradural tumors, mostly benign (neurofibroma), generally produce a total block with a transverse or curved (cap picture) border. The tooth-like picture is also typical. Adhesive spinal arachnoiditis, the lesions of which may simulate cord tumors, gives different pictures, depending upon whether the lesions are localized or diffused. Local adhesive arachnoiditis gives a characteristic picture which may be compared in shape to the teeth of a comb. In the diffused forms, which may give the same clinical picture, the lipiodol is dispersed into numerous drops, arrested by the subarachnoid veils at different levels, the remaining part being arrested completely a little lower down. Vertebral diseases compressing the cord—Pott's disease, acute spondylitis, cancer, etc.—may cause total block and the lipiodol picture may simulate that of a tumor. But generally a careful clinical examination and a good roentgenogram of the spine will show the vertebral cause of the compression.

There are two instances wherein most commonly the lipiodol ball is partially arrested in its course: (1) adhesive meningitis; (2) intramedullary tumors. In intramedullary tumors or syringomyelia the shadow cast by lipiodol consists generally of two elongated and festooned lines along each side of the spinal canal, between which is seen the fusiform shape of the enlarged medulla. All the diseases causing complete block at an advanced stage of their evolution can cause a partial one at the beginning.

From the results in 12 recent cases, the authors believe that by employing the lipiodol test, under roentgenoscopic control, spinal block may be detected at an earlier period of its evolution than by any clinical or manometric method. It is the only examination which affords direct localization.—*J. D. Camp.*

Fraser, Robert H. Diagnostic uses of lipiodol in the paranasal sinuses. *Radiology*, January, 1929, xii, 6–23.

In the use of iodized oil in the sinuses a number of principles demand observance. The standard direction of the rays is horizontal but use of dilutions of the lipiodol, stereo positions, and certain directions of oblique, inclined, and vertical radiation often quickly excludes pathology. Complete fillings are most useful and are obtained by injection, which is the more frequent method of choice in the presence of outspoken disease. Small rim floor fillings are helpful in the sphenoids. Displacement (suffusion) fillings are the method of choice for the smaller sinuses and for early cases: they give evidence of choked sinus, or filling defect, or delayed emptying (Proetz). Examinations in the original position of the filling are valuable.

From a purely roentgenographic point of view, the method (1) reveals beginning changes earlier, demarcating soft tissue growth; (2) multiplies the number or extent of separation lines, rendering them capable of interpretation; (3) results in the reporting of thicknesses and masses as well as density. The reports are in concrete physical terms, avoiding terms of pathological diagnosis in cases in which the roentgen finding is not pathognomonic.

The following substantial advantages may be expected if a commensurate degree of attention is given to the case: (1) Exclusion from the list of pathologic diagnosis of any sinus which, solely because of anatomical peculiarity, is cloudy to transillumination and primary roentgen-ray examination. (2) Exclusion of unaffected sinuses, *e.g.*, sphenoid, maxillary, or frontal in hyperplastic ethmoiditis. Also extension to the sinuses of neighborhood inflammation or malignant growth (McKelvie). (3) The revealing of such pathological anatomy as serves as a check on progress under conservative treatment over a period of time (Weil). (4) Contribution to statistics, so highly desirable as to what grades of anatomical change in the various inflammations are capable of resolution without radical surgery. (5) Guidance in the type of operation to be used and the direction of approach and of drainage (Reverchon and Worms). (6) Demonstration of the pathological material which is to be removed, with site of attachment of polypi, etc. (Brunetti and Filippini.) (7) A check on the success or failure of any preceding surgical procedure. (8) Encouragement for conservative treatment in bad risk cases or when annoying chronic symptoms might ensue and be blamed against the operation.—*J. D. Camp.*

Friedman, Lewis J. Iodized oil in roentgenology. *Radiology*, February, 1929, xii, 114–126.

The author reviews the literature and his experiences with iodized oil in roentgenology. The following conclusions are stated: (1) Injections of iodized oil are innocuous in the nasal accessory sinuses, eustachian tubes, and the lachrymal ducts. (2) Exploration of the bronchial tree is comparatively harmless, but cases must be selected. It is contraindicated in tuberculosis and hyperthyroidism. (3) Injection of iodized oil in the renal tract is inexpedient. Better results may be had by injecting sodium iodide solution. In exploration of the uterus for pathology, the results are infallible and harmless. (4) Meningeal exploration must be made with caution.

Iodized oil, whether used as lipiodol or iodipin, in commercial strength or diluted, is an excellent opaque medium in roentgenology.—*J. D. Camp.*

Gantenberg, Robert. The significance of deforming processes of the vertebral column, with special consideration of the occurrence in miners. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 650–656.

Based on a material of 470 cases it was found that spondylitis deformans is rather frequent in miners. Coexistence with backache, arteriosclerosis and rheumatism is often encountered. It appears that spondylitis deformans is an occupational disease and it is therefore suggested that a thorough investigation be carried out in different mining districts in order to elucidate the part occupation has in the etiology of this disease.—*T. Leucutia.*

Giongo, Franco. A particular traumatic alteration of the long bones in young individuals. *Radiol. med.*, Jan., 1929, xvi, 63–74.

The author describes 13 cases of a traumatic fracture localized to the metaphysis of the long bones in individuals from six to fifteen years of age. The cases are illustrated with numerous roentgenograms and drwaings.

After a review of the literature dealing with traumatic injury to the long bones in the different stages of development, the author arrives at the conclusion that the cases presented belong to a separate entity which has been variously described in the literature. Kohl (1905) used the term "particular fracture of the cortical bone;" De Quervain (1907) "compression fracture;" Helferich (1909) "incomplete infraction;" Putti (1911) "traumatic curvature;" Iselin (1912) "compressive fracture;" Grashey (1924) "greenstick rup-

ture;" Lusena (1926) "greenstick fracture," and Schinz "circinate fracture." The author suggests the name of "cortical incurvation" since the fracture is confined only to the external strata of the corticalis and since a slight incurvation of the metaphysis always results. The lesion is typical of the ages from five to fifteen, and may be placed in the chronological scale of adolescent injuries after the subperiosteal fracture of first infancy and greenstick fracture of second infancy and preceding the epiphyseal separation of adolescence and the typical fractures of adults.—*T. Leucutia.*

Hessenthaler, Maria. Contribution to enchondromatosis of the skeleton—Ollier's disease. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 645–650.

A case of multiple enchondromatosis of the left upper and left lower extremities is described in a boy twelve years of age. Diagnosis of Ollier's disease was made (1) since the disease was localized exclusively to the left side and (2) since the condition was associated with disturbances in growth.

Bentzon's theory as to the vegetative nervous origin of the disease was accepted as the most plausible.—*T. Leucutia.*

Hickey P. M. Radiography of normal larynx. *Radiology*, 1928, xi, 409–411.

The roentgenologic examination of the larynx is oftentimes of importance in studying the changes produced by benign neoplasm, carcinoma, and tuberculosis.

The male larynx is distinguishable from the female larynx by the greater lime deposit of the thyroid cartilage in the male; in the female, the thyroid shows only a very slight lime deposit, while the cricoid is usually conspicuously outlined.

The maximum amount of information is gathered from a lateral exposure, the anteroposterior being of little value on account of the overlying shadows in the cervical vertebrae. The lateral exposure may be made on a 5″ × 7″ film in a cassette with a narrow edge. A cassette of larger size with a wide edge is inconvenient and the wide edge will often cut off part of the tissues under examination. With a small 5″ × 7″ cassette the film can be accurately placed so as to show the shadows of the laryngopharynx, the larynx, the trachea for some 2 or 3 inches, the upper portion of the esophagus, and the cervical vertebrae.

Usually the amount of the trachea which can be shown will depend upon the body habitus, more difficulty being experienced with patients with a short neck. The skin target distance should be at least 30 inches, preferably 36 inches. In patients with a short neck and in cases where one desires to include as much of the trachea as possible, the larger cassette, an 8″ × 10″ or a 10″ × 12″, may be supported beyond the shoulder and the tube removed to a distance sufficient to minimize the enlargement.—*J. D. Camp.*

Hinrichsen, H. M. Calcified cysticerci in the musculature. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 666–669.

Two cases are described and roentgenograms are presented in which numerous calcified cysticerci were observed practically throughout the entire body. The cysticerci were situated partly between the skin and muscle and partly within the muscles themselves.—*T. Leucutia.*

Hopkins, Ralph. Bone changes in leprosy. *Radiology*, 1928, xi, 470–472.

Leprosy affects primarily the skin or nerves. The skin type is totally different in its symptomatology from the nerve type, but combination of the two types in the same individual is frequent. The type is dependent on the habitat of the *Bacillus hansenii*, which is found either in the skin or nerves, or both. Bone changes are usually found in both types of the disease and the most marked and most rapidly advancing changes occur in cases of the mixed type, presenting both skin and nerve lesions.

The most notable changes occur in the phalanges of both extremities and in the nasal septum, while the bones of the trunk and the long bones of the limbs remain unaffected. Like other symptoms of leprosy, there is often a curious limitation to the most peripheral parts; cases even of long duration may show no bone changes except in the most distal phalanges. Disintegration occurs in the epiphyses as well as diaphyses.

The time factor involved in the loss of bone is widely variable but most often the process is very slow. Ten, twenty, or thirty years may elapse while the digits are gradually shortening on account of a slow bone absorption. When suppuration with secondary infection occurs, however, the course is much more rapid.

Actual loss of bone causing the mutilation of hands and feet characteristic of leprosy occurs in several ways. There may be an absorption without any external evidence of inflammation or suppuration. The bone loss is followed by retraction of the soft tissues, remnants of the nails often remaining even when the digit has completely disappeared.

In other cases the condition which has been

called ainhum occurs. A narrow constricting band of fibrous tissue encircling the finger or toe appears, which, gradually growing tighter, indents the digit as would the wearing of a ring that was too small. The identation grows deeper until but a cord or thread remains as a connecting link. This finally breaks.

More commonly, necrosis of bone is associated with suppuration, the formation of sinuses, and secondary infection. Gangrene may occur, necessitating surgical amputation. In neglected cases the amputation is spontaneous. Associated with the sinus leading to necrotic bone is the perforating ulcer, which occurs most often on the ball of the foot. These ulcers persist almost indefinitely if the dead bone is not absorbed, spontaneously discharged or surgically removed.—*J. D. Camp.*

Huber, Julien, and Advenier, William. A case of multiple chondromatosis. *Bull. et mém. Soc. méd. d. hôp. de Par.*, March 25, 1929, liii, 371–385.

The authors report a case of multiple chondromatosis involving the right hand and wrist, with subluxation backward of the radius due to the shortened ulna, the right scapula, right fibula, tibia, tarsus and foot. The lesions showed typical chondromatous changes, confined to the lower portions of the extremities except for the scapula. The question has been raised whether this condition is distinct or is associated with multiple cartilaginous exostoses. Multiple chondromatosis is often limited only to digital involvement. Lenormant and Le Cene consider chondromatosis analogous to multiple cartilaginous exostoses.

Léri in the published discussion of this paper describes two types of the disease, (1) limited to the hands and fingers, and (2) diffuse, involving not only the hands and the fingers, but also numerous long bones of the extremities. The diaphyso-epiphyseal region is affected, the lesions are usually symmetrical, and their localization often recalls multiple cartilaginous exostoses. The lesions, however, do not show osteophytes or the ecchondroses that precede them, as is the case in the latter.—*R. S. Bromer.*

Jenkinson, Edward L. Diverticula of the small bowel. *Radiology*, February, 1929, xii, 100–104.

The author reports 3 cases of diverticula of the small bowel beyond the duodenum. Two of these cases showed a single diverticulum in the jejunum and the other showed multiple lesions in the jejunum and ileum (proved at operation).

Diverticula of the jejunum and ileum are not so common as diverticula of the duodenum. Their location makes them difficult to identify. Diverticula of the jejunum and ileum are usually multiple.

The symptoms are indefinite, with no special localization, the most common being epigastric distress accompanied by eructation of gas. The symptoms usually date back a number of years, during which period there has often been intermittent vomiting. A troublesome diarrhea, which has persisted for years, is also a common symptom. The patient complains of a progressive weakness and loss of weight, and the usual diagnosis is carcinoma.—*J. D. Camp.*

McPhedran, F. M., and Weyl, C. N. The value of synchronization in accurate diagnosis of chest diseases. *Radiology*, 1928, xi, 458–462.

Synchronization as applied to chest roentgenography means making exposures at a selected phase of the cardiac cycle. By synchronization with late diastole, films may be made at a time when cardiac movement is at a minimum. This is the most satisfactory phase in which to secure good lung detail.

The effects of systolic discharge in causing blurring are most strikingly seen in the shadows of structures adjacent to the heart. Exposures of $\frac{1}{20}$ second made during systolic discharge show a blurred, ill-defined hilum shadow made up of the arterial main stem and the venous and bronchial branches which cross it. Exposures of $\frac{1}{20}$ second made during diastole show the arterial main stem shadow and its branches sharply defined, crossed by a few venous and bronchial trunks. When such contrasts in appearance can be secured in films of the same individual on the same day, merely by timing the exposure to occur at different phases of cardiac activity, there is no doubt that the difference in the appearances has not a pathological but a physiological basis.

Children suffering from an acute respiratory infection, with elevation of the pulse rate and consequently more frequent systole, are still more likely to show decided blurring of the hilum shadows and trunk markings unless the exposures are synchronized to occur in diastole. During the study of latent tuberculosis carried on at the Henry Phipps Institute during the past four and a half years, the authors examined many children before, during and after acute respiratory infections and were never able to verify, in synchronized films, enlargement or increased density of the hilum region referable to acute infections. It is doubtful whether any other part of the lung field is as much affected by artefacts and extraneous shadows as the hilum.

The actual structures of the hilum are the artery, the bronchus and the vein, with their branches, and the intrapulmonary lymph nodes. So far as they can be recorded on the film, the most important of these is the arterial main stem shadow, not for itself but because of its relation to the majority of the intrapulmonary lymph nodes. These nodes, situated at the large bronchial branches, lie lateral to the bronchial main stem, that is, upon the arterial main stem, and are surrounded and crossed by the branches of artery, bronchus, and vein. So situated, they do not cast a distinctive shadow. Their density and their outlines are merged with the similar density and tangled outlines of the trunks which surround them. In order that these lymph nodes may become individually perceptible, they must enlarge so much that their borders project lateral to the lateral margin of the arterial main stem shadow and thus contrast with the air-bearing parenchyma into which they protrude. In a series of about 150 excised inflated lungs, practically all seats of a more or less severe bronchitis, many showing acute bronchopneumonia, the authors saw no instance in which the lymph nodes did so project, nor any in which the presence of acutely swollen edematous nodes could be inferred by any increase in density of the hilum shadow. Similarly, caseous nodes, unless the seat of calcium infiltration, cast no distinctive shadow in the excised lung series. In only 5 instances, all in colored children, have the authors seen non-calcium-bearing nodes, presumably caseous, projecting as rounded masses lateral to and in one instance also medial to the arterial main-stem shadow. These children were well but all had strongly positive tuberculin reactions. Calcium infiltration of a caseous necrosis, even if discrete and impalpable on section, casts a distinctive shadow, granular, crenated, lamellated. Its presence may be readily detected in synchronized films of the living. The walls of the bronchi tangentially irradiated may cause a similar and misleading appearance in the flat film but will rarely cause difference stereoscopically. The presence of calcium is of importance as an index of severe infection. It is not to be regarded as an indication of obsolescence of the lesion, unless it is dense, sharply defined, and associated with a weak tuberculin reaction. In view of some descriptions of so-called hilum tuberculosis, it is perhaps deserving of note that progression of caseation through the capsule of a lymph node and diffuse infiltration of the areolar tissue of the hilum is quite exceptional, and in the authors' cases was associated with rupture of a node into a vessel or bronchus, and fatal tuberculosis.

For practical purposes, roentgenologic diagnosis of pulmonary arterial disease, other than congenital anomalies, is rare. The veins, on the other hand, are not only the first part of the pulmonary circulation to show roentgenologically perceptible change in certain cardiac lesions, but normally the veins cast the majority of the shadows, as can be seen in synchronized films. Particularly if the right side and shoulder are rotated away from the film and the film slightly over-exposed, the majority of the trunks in the lung field, except the large arterial trunks running directly down to the diaphragm, may be traced back across the arterial main stem and the bronchus into the heart. With synchronized exposures, it is possible to recognize by generalized prominence of venous trunks many cases of cardiac lesion in which the heart size gives no definite evidence of abnormality.

Although it is common to hear the shadows in the pulmonary fields described as bronchi, even in the excised inflated lung the healthy bronchi can only rarely be traced beyond the inner third of the lung field as characteristic double-contoured branching lines. When the bronchial walls are irregularly thickened and dilated, as in chronic bronchitis associated with emphysema, a few bronchi can be traced into the middle and rarely into the outer third of the lung field. This is partly due to increased density of the bronchial wall as compared with the parenchyma, and, in the living, partly due to the decreased elasticity of the lung and the consequently decreased movement of the bronchi which accompany the artery. When bronchiectasis is slight and when it is responding to treatment and expectoration is scant, recognition of the lesion is immensely aided by synchronization. The differential anatomical diagnosis from the primary or infantile type of diffuse tuberculous infiltration is usually rendered decisive in synchronized films. In contrast to the linear, arborizing disposition of shadows of bronchiectasis, the densities of diffuse tuberculous infiltration form an irregular network which can usually be seen to arise from the pleura and to send interlacing, diminishing, often noded strands towards the hilum.

Localized prominence of trunk markings in roentgenograms of the living, apart from bronchiectasis, is chiefly seen, if asymmetrical, in areas of infiltration. It is common in areas of tuberculous infiltration whether of apical or childhood type and in areas of nonspecific bronchopneumonia. Commonly one finds such

roentgen-ray appearances ascribed to thickening of trunks, to peribronchial lymphangitis, or to a peribronchial tuberculosis. The last has not a pathological counterpart or basis. It is doubtful if an uncomplicated lymphangitis occurs sufficient to add roentgenologically perceptible density to bronchus, vein or artery. And when one roentgenographs excised inflated lungs one finds that trunks of supply to infiltrated areas are no more prominent than trunks in comparable areas free from infiltration. Furthermore, pathological section shows that selective deposition of tubercles about those arteries, bronchi, and veins, large enough to be roentgenologically recorded, does not occur.

The increased prominence and definition of trunk shadows as age advances are due to slower heart rate and to increase in the length and in the diameter of trunks. The interpretation that the appearance of thickening of trunks is due to the deposit of fibrous tissue resultant on successive respiratory infections lacks a basis in pathology.—*J. D. Camp.*

Markó, Desiderius. Contribution to the roentgen diagnosis and roentgen therapy of actinomycosis of the lungs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 629–640.

Three cases of actinomycosis of the lungs are described in which the roentgenograms showed opacities of various degrees. In none of the cases was there a typical appearance so that the diagnosis had to be made on the sputum examination.

The treatment consisted in the administration of rather heavy doses of roentgen rays, with a combination of iodides. In one case which was early a complete recovery was obtained. The opinion is expressed that irradiation should always be used before attempting surgical procedures which are greatly mutilating and very dangerous.—*T. Leucutia.*

Nichols, B. H. Lipiodol in its relation to chest diagnosis. *Radiology*, January, 1929, xii, 1–5.

The catheter method of injection has been the author's method of choice for the demonstration of pulmonary lesions. The patient is referred to the Nose and Throat Department, where, after local anesthetization, the catheter is passed into the trachea. The patient is instructed to grasp the catheter between the teeth, and is then taken to the Roentgen-ray Department. If previous examination of the chest has shown the lesion to be located in the lower lobe of either lung, the patient is placed before the roentgenoscope with the body tilted towards the side in which the injection is to be made. The catheter is filled with lipiodol under the roentgenoscope and is introduced into the right or left bronchus, as is desired. The lipiodol is then injected slowly under observation until the periphery of the lung is reached or the desired area is outlined, when the injection is immediately discontinued and roentgenograms are made.

If the lesion is in one of the upper lobes of the lung, the patient lies on the affected side, with his head lowered. It is thus possible to introduce the lipiodol without difficulty into a single upper lobe of the lung.

This method of introduction has a great many advantages, as usually only a small amount of lipiodol is necessary, and confusing shadows are eliminated by the avoidance of the overfilling of any portion of the lung. The method is particularly applicable for the study of bronchiectatic areas and also for the differentiation of tumor masses in the lung tissue or in a bronchus from those in the pleural cavity.

After a patient has been subjected to examination by this method it should be borne in mind that iodized oil is absorbed by the hilus glands, so that in subsequent examination of the chest by plain films the shadows of these glands may not be interpreted as being due to calcific infiltration.

For the observation of patients with lung abscesses the bronchoscopic method is best, as it is quite essential that the abscess cavity be aspirated before the oil is introduced. This can usually be done through the bronchoscope. Moreover, in addition to the aspiration of the abscess cavity a foreign body may sometimes be seen to be the primary factor in the production of a lung abscess, a finding which is usually not made when lipiodol is injected by any other method.

Also in cases of non-tuberculous lesions of the chest in which there have been hemorrhages from the lung, bronchoscopy should be employed before ordinary oil injections are made. By means of the bronchoscope, specimens of granulation tissue or of a malignant lesion of the bronchus may be taken for pathological examination, thus making possible a positive diagnosis which could not be secured by the injection of lipiodol alone.

In the presence of the following conditions the injection of lipiodol is contraindicated: pulmonary tuberculosis, hyperthyroidism, advanced cardiac disease, and any marked elevation of temperature.

The greatest value of pulmonary lipiodol injection is in the diagnosis of bronchiectasis and lung abscess. It also has been of extreme value in the differentiation of lesions in the

pleural cavity from lesions of the lung tissue, such as tumor and pneumonitis. The outline of the trachea after the injection of iodized oil may aid in the definition of a mediastinal tumor or aneurysm, as the extent and location of compression or displacement of the trachea may be clearly shown.—*J. D. Camp.*

Ochsner, Alton. Bronchography according to the passive technic: the method of choice for the roentgenologist. *Radiology*, 1928, xi, 412–422.

Irrespective of the type of procedure employed to introduce the contrast medium into the tracheobronchial tree, it is absolutely imperative to observe the case roentgenoscopically, and it is also important to observe the tracheobronchial tree during the introduction of the oil, so that the mode of filling of the bronchi may be noted. Roentgen plates should be used only for confirmation and record. Because the iodized oil may be aspirated into the alveoli within a very short period of time after the introduction of the oil, a haziness of the lung field is obtained, due to the presence of the oil in the alveoli. This very commonly obscures the outline of the bronchi, so that a dilatation may be overlooked.

Another error may be made if the roentgenogram is depended upon for diagnosis. In the anteroposterior view those bronchi located at the greatest distance from the plate will, because of their distance, appear larger and give a mistaken idea of bronchial dilatation. This error may be easily obviated by a roentgenoscopic examination, because, as in the ordinary gastrointestinal roentgenoscopy, the patient is not only observed in the anteroposterior position, but is turned in various directions. In this way it would be impossible to have two parallel bronchi superimposed upon each other in such a manner as to give a false impression of a bronchial dilatation.

Bronchography, in order to be useful, should be of such a nature as to be executed without being unpleasant for the patient or difficult for the physician. The "passive" technique of bronchography, which has been reported in detail in previous publications, fulfills all of these requirements. The technique is extremely simple and easy to carry out, requiring no special training nor special apparatus. The only instruments used are two sterile medicine glasses, several cotton applicators, and a tongue depressor.

After cleansing the mouth with an antiseptic mouth wash, the anterior surface of the anterior tonsillar pillar is swabbed with a 10 per cent cocaine solution. The anesthetic solution is applied to the whole anterior pillar from the uvula to the angle between the anterior pillar and the tongue. The anesthesia is continued until the swallowing reflex is abolished. As evidence that this has been accomplished, the mobility of the larynx during attempted deglutition is observed. As soon as the larynx remains immobile upon attempted deglutition, the anesthesia is complete. The patient is then given 3 to 4 c.c. of a 3 per cent novocaine solution and instructed to tip the head backward, protrude the tongue, lean towards the affected side, and breathe.

Following this procedure, the anterior pillars are again painted with 10 per cent cocaine and the patient placed behind the roentgenoscopic screen. The effect of the application of cocaine to the anterior pillar is only temporary, usually lasting from one to two minutes. It is, therefore, imperative to make an application just previous to the placing of the patient behind the roentgenoscopic screen. While under the screen the patient is instructed to take 10 c.c. of the iodized oil into his mouth and aspirate it into the tracheobronchial tree in the same way in which the novocaine solution was aspirated. By means of the roentgenoscope, the oil is seen to enter the larynx, fill the pyriform sinus of the larynx on each side, pass through the trachea, and into the bronchus. The lobe filled depends upon the side towards which the patient is leaning, *i.e.*, if the patient leans to the right the right lower lobe fills, and vice versa. The patient is then turned in various directions, in order to rule out any apparent dilatation caused by the bronchi's being located a greater distance from the screen. Any deviations from the normal bronchi, either in course or contour, are carefully noted.—*J. D. Camp.*

Ottonello, Pietro. The lateral sinistrodextro projection of the ileocecal colonic tract. *Radiol. med.*, Jan., 1929, xvi, 74–90.

The value of the lateral projection of the ileocecal colonic tract following the administration of the barium meal was determined in 15 normal cases and the following conclusions were reached: (1) The lateral projection of the ileocecal colonic tract is of great aid in demonstrating retrocecal appendices. Of 15 cases examined a retrocecal appendix was found in 4 cases (26.6 per cent). (2) It is also important from the point of view of establishing the relation of the ascending colon and the cecum, as well as for the demonstration of their respective positions. (3) It permits the recognition of pseudo-dilatations of the ascending colon due to superimposition of the ascending colon and the first portion of the transverse colon. (4) Occasionally it also evidences the B and H sphincters.

It is recommended that the examination of the ileocecal colonic tract in the lateral view always be made a part of the routine examination.—*T. Leucutia.*

Railsback, O. C., and Dock, William. Erosion of the ribs due to stenosis of the isthmus (coarctation) of the aorta. *Radiology*, January, 1929, xii, 58–61.

The authors describe a patient with asymptomatic stenosis of the isthmus of the aorta in whom there was a comparatively small degree of superficial collateral circulation, but with numerous erosions of the third to ninth ribs in the roentgenogram as evidence of dilated intercostal vessels. The delay in transmission of the pulse to the femorals confirmed the existence of stenosis of the aorta.—*J. D. Camp.*

Salmond, R. W. A. Observations on the movements of the duodenal contents, with special reference to antiperistalsis and pyloric regurgitation. *Radiology*, 1928, xi, 453–457.

The following observations were made in opaque meal examinations, with special attention to the duodenum and pylorus, no aperient having been taken during the previous thirty-six hours. The meal consisted of 4 to 6 ounces of barium sulphate held in suspension in a pint of malted milk at body temperature, its passage being watched through the stomach and duodenum with the patient in varying positions. The movements of the duodenal contents are not only very complex, probably more so than in any other part of the alimentary tract, but also subject to variation in different subjects. The following is a summary of what has been observed of the movements of the food in the normal duodenum after the age of infancy:

1. Peristalsis and antiperistalsis of the cap, usually called contraction of the cap.
2. Peristalsis and antiperistalsis of the second and third parts.
3. Segmentation or mixing movements of the second and third parts.
4. Forward movements en bloc due to the downward inspiratory movement of the diaphragm, especially affecting the second part.

These have been seen, not only in normal cases but also in the various pathological conditions of the stomach, duodenum, appendix and gall-bladder.

Duodenal antiperistalsis is undoubtedly frequently observed and the crux of the problem would appear to be the evaluation of its significance. Is it (*a*) a normal process, or (*b*) due to the abnormal meal, or (*c*) merely one of the roentgenologic signs of duodenal irritation, stasis, or obstruction, or delay even farther on? The writer is inclined to favor the first for the following reasons: (*a*) The large percentage of cases in which it has been observed when carefully looked for, many of the cases being "normal" subjects; (*b*) it is also seen when small meals are given, and in the upright, the supine, and the prone positions, and (*c*) it is seen during all stages of the stomach emptying and with no delay in the complete emptying of the duodenum.—*J. D. Camp.*

Spiller, Ulrich. Contribution to the roentgenologic visualization of non-calcified, peripheral vessels without the use of contrast media. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 660–666.

There is a great dissension with regard to the roentgenologic demonstrability of non-calcified peripheral vessels. The author undertook to investigate the problem by making roentgenograms of the elbow region with an exposure so as to demonstrate the soft structures (130 volts, primary, 26 ma., 50 cm., 2 sec., 50 kv.; 150 volts, primary, 30 ma., 55 cm., 4 sec., 67 kv., and 140 volts, primary, 25 ma., 55 cm., 3 sec., 53 kv.).

It was found that the normal blood vessels of the arm can be demonstrated with great regularity. Differentiation between arteries and veins, however, is not possible. Similar experiments with blood vessels in other regions were unsuccessful, partly because of the thick musculature, such as for example in the lower extremities, or because of the very thinness of the blood vessels themselves, as in the hands and feet. Thus the elbow is the only region where normal blood vessels may be visualized roentgenologically.—*T. Leucutia.*

Stein, I. F., and Arens, R. A. Iodized oil and pneumoperitoneum in roentgen gynecologic diagnosis. *Radiology*, April, 1929, xii, 341–344.

As a result of increased experience, the authors have become more cautious in the diagnosis of tubal obstruction, and consider spasm to be a definite and frequent phenomenon in normal pelvic viscera. They feel that spasm as exhibited in the uterus and tubal isthmus is comparable to spasm observed in other hollow viscera, and is a defense reaction against the introduction of a foreign substance or against distention.

This phenomenon accounts readily for the numerous cases in which they found apparent obstruction in which gas alone was used for testing tubal patency and in which on repeated tests the tubes proved to be patent. This was graphically illustrated when iodized oil was

utilized showing one or both tubes patent immediately following the usual patency test with gas in which the tubes appeared to be obstructed.

The converse has also been observed, namely, that after a satisfactory patency test with gas the instillation of iodized oil yielded a typical picture of cornual or isthmic obstruction. Again, one tube has appeared filled and the other empty.

The experience of the authors emphasizes the necessity for repeated patency tests when obstruction is encountered, especially in the absence of obvious inflammatory lesions.—*J. D. Camp.*

v. FRIEDRICH, L. The diagnostic importance of air in the biliary tract. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 616–619.

Two cases are described in which free air was demonstrated in the biliary ducts. The first case was that of a carcinoma of the head of the pancreas in a man thirty-six years of age. Following cholecystoduodenostomy the roentgen examination revealed the presence of air in the gall-bladder, gall ducts, intrahepatic biliary ducts, as well as in the duodenum.

The second case was that of a woman sixty-two years of age suffering from typical symptoms of gallstones. Cholecystography was negative for evidence of gallstone shadows but free air was found in the gall-bladder and biliary ducts.

While in the first case the entering of the air into the biliary tract is well explained by the operation, in the second case this was due to perforation of the gall-bladder and fistula formation into the duodenum. The conclusion is reached that the presence of air in the biliary passages indicates a fistula between the biliary tract and the bowels.—*T. Leucutia.*

v. HECKER, HANS, and KELLNER, FRANK. The diagnosis of cysticercosis of the lung in the living. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 624–628.

A case of multiple echinococcus cysts of the lungs in a man twenty-seven years of age, is described and illustrated with several roentgenograms. The roentgenograms showed rounded, sharply outlined areas of decreased translucency scattered throughout both lungs. Some of the areas were entirely homogeneous, others showed a pea-sized central nucleus. The appearance was somewhat similar to that of tumor metastases to the lungs.—*T. Leucutia.*

ZATKIN, S. The question of Scheuermann's disease. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 657–658.

In 1921 Scheuermann described for the first time a condition of curvature of the spine with wedge-shaped deformity of the vertebrae occurring especially in adolescents and resulting in kyphosis. The condition was classed into the group of osteochondritis (related to osteochondritis deformans juvenilis).

The author observed a similar condition in a man forty-two years of age. The roentgenogram of the spine taken in the lateral view was typical of Scheuermann's disease.—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

ALBERT, WOLFGANG. Statistical investigations on skin tuberculosis. *Strahlentherapie*, 1929, xxxii, 309–321.

Nine hundred and twenty-three cases of skin tuberculosis were treated between Oct. 1, 1915 and Sept. 30, 1928, by roentgen therapy. The cases are tabulated according to the different clinico-pathological forms but the method of treatment is not indicated and no data are given on the results obtained. In 2.2 per cent of the lupus cases a carcinomatous degeneration occurred previous to the treatment, this indicating that lupus carcinoma is not the result of roentgen irradiation.—*T. Leucutia.*

BÉCLÈRE, A. Radiotherapy of adenomas of the hypophysis. *Bull. et mém. Soc. méd. d. hôp. d. Par.*, March 4, 1929, liii, 306–313.

The present communication is supplementary to one made by Béclère in 1909, under the title of the "medical treatment of tumors of the hypophysis, of gigantism, and acromegaly, by radiotherapy." Before 1909, attempts had been made to irradiate hypophyseal tumors by way of the buccal cavity, but these attempts were ineffectual, with but one exception, the case reported by Grogmegna of Turin. His success however was only temporary. He twice succeeded in a female patient, in arresting and securing regression for seven months' interval, of the visual disorders and the headache, due to an hypophyseal tumor. The patient later succumbed.

Béclère evolved a new technique after his original publication in 1909. The external surface of the cranium formed by the frontal bone, the anterior portion of the parietal, the squamous portion of the temporal, and a small part of the wing of the sphenoid, forms a quarter of a sphere which has for its center the hypophysis. By means of a localizing device, the central rays can be directed over the hypophysis in a very accurate fashion. Three

or four areas were treated in each case, and the depth dose given the hypophysis was triple or quadruple the superficial dose compatible with safety to the skin. By using this technique Béclère secured amelioration of all symptoms in one case of hypophyseal tumor after 16 treatments, through four ports of entry, two frontal and two temporal. Jaugeas reported 3 more cases in 1913, using this method with success. Later observers, Kupferle and Szily, Heinismann and Czerny, Bremer, Copper and Sluys, have also confirmed Béclère's original report. In 1914 Béclère again reported additional cases in which he secured amelioration or complete dispersal of symptoms. In cases of gigantism, radiotherapy, while not resulting in regression of skeletal deformities, stops their further development.

He quotes Cushing's classification of hypophyseal tumors, and also Dodd and Bailey in great detail on the results of radiation therapy in this type of brain tumors. He congratulates Clovis and Martel who reported 8 cases operated upon and cured. He does not agree with them, however, that radiotherapy is not legitimately used except in hypophyseal tumors which do not present signs of intracranial hypertension, or optic nerve compression. He thinks radiation should first be tried in all cases and if there is no response, then surgical decompression or transsphenoidal removal should be attempted.—*R. S. Bromer.*

Carter, L. J. Analgesic properties of the *x*-ray. *Radiology*, January, 1929, xii, 27–32.

When roentgen therapy is instituted primarily for the relief of pain, heavy dosage should not be used. Better and safer results will be secured from the smaller dosage.

In trigeminal neuralgia, chronic mastitis, herpes zoster, furunculosis and carbuncle, abdominal and pelvic inflammatory adhesions, and tuberculous peritonitis, the following factors have been found the most effective: 113 peak kv. (9 inch spark gap); 5 ma.; 10 inch focal skin distance; 5 mm. aluminum and 6 mm. sole leather filter; 5 minutes. This dosage is repeated once a week until relief from pain is well established, and then the intervals are increased and the treatment continued according to the needs and progress of the individual patient and the particular disease treated.

The tongue paresthesias are treated in the same way as benign skin lesions, namely, by unfiltered radiation. The following factors have been found effective: 63 kv. (5 inch spark gap); 3 ma.; 8 inch focal skin distance; 3 minutes. This is repeated in from five to seven days. It should not be continued longer than three or four treatments without increasing the interval between treatments.—*J. D. Camp.*

Cignolini, Pietro. Local and general effect of roentgen therapy in a case of diabetes insipidus associated with osteopathy. *Radiol. med.* Jan., 1929, xvi, 16–21.

A case of diabetes insipidus associated with disturbances in the normal bone structure is decribed in a boy fourteen years of age. The bone changes consisted in areas of decalcification with multiple localization (mandible, cranium, ilium, upper ends of the femora, ribs, etc.).

Roentgen therapy was directed first to the left upper femur (½ S.U.D., through 0.5 mm. Zn and 2 mm. Al, field 7 × 9 cm.), later to the pelvis, to the opposite femur, mandible and ribs, a dose of from ¼ to ½ S.U.D. having been administered over the individual areas.

The irradiation has led to prompt and remarkable results. There was a rapid improvement in the bone changes, with complete disappearance of all the symptoms and there was healing of the diabetes insipidus. Not sufficient time has elapsed since the treatment to draw final conclusions, but it appears that roentgen therapy was of considerable value.

Since irradiation has produced a simultaneous improvement in the bone changes and diabetes insipidus it is thought that the osteopathy was a secondary condition to the diabetes insipidus.—*T. Leucutia.*

Dubowy, E. D. Results of application of roentgen rays in polycythemia rubra. *Strablentherapie*, 1929, xxxii, 343–355.

Six cases of polycythemia rubra (5 men and 1 woman) which were treated by roentgen irradiation are described in detail. The results obtained were: in 2 cases very good; in 2 other cases moderate and in 2 cases only slight, resulting chiefly in symptomatic improvement.

It is advised that penetrating rays be used by administering 5 to 6 erythema doses in eight to ten sittings over the long bones and by repeating the treatment in case of necessity at two months' intervals. The control of the blood by means of numerous blood counts during the period of irradiation is essential. The conclusion is reached that all cases of polycythemia rubra should be submitted to irradiation.—*T. Leucutia.*

Duffy, James J. The use of gold-filtered radon seeds. *Radiology*, February, 1929, xii, 93–98.

The total radiation transmitted by the gold-filtered seed is only 3.16 per cent of that which

is transmitted by the glass seed. With glass seeds the dosage of beta rays adjacent to the seeds is far in excess of that amount of radiation necessary to destroy the growth. The intense beta radiation ceases more or less abruptly, leaving the more penetrating gamma rays to produce an effect at greater distances. With gold seeds, the beta effect is relatively little, but the double amount of radon practically doubles the amount of gamma radiation.

It is advisable to employ, for a given lesion, the same number of gold seeds as it was customary to use of the glass seeds, but the radon content should be about double. That is, if a glass seed of 1 mc. was formerly buried, a 2 mc. gold seed is now used. This is not an absolute rule, but a basis to which clinical judgment must be added. In especially large tumors consideration must be given to the fact that there is a greater amount of gamma ray from gold tubes, therefore a more distant effect. Consequently a slightly smaller total dosage is given, either by a few less implants, or a lesser amount in each implant.

In tumors involving the mucous membranes gold implants have attained their greatest triumph over glass seeds, for with gold seeds in these locations, destruction of new growth has been accomplished with much less pain, showing no gross external tissue necrosis, with consequent sloughing and danger of hemorrhage; nor is it necessary to frequently remove by cautery large portions of tissue, necrotic and normal, because of slough and infection. With gold seeds it is usual to obtain complete regression of the new-growth, while the contour of the region remains nearly normal.

The main variation in the reaction of the ulcerated lesions treated with filtered radon is the regression without sloughing, even disappearance of the disease, followed by slowly proceeding epidermization of the area.

A glass seed placed within necrosing distance of a nerve will result in a severe neuritis or destruction of the nerve trunk. Though nerve tissue is resistant to radiation, it cannot withstand the caustic beta rays of radium. A quantity of gamma rays, just sufficient to destroy most types of neoplastic cells, will not permanently injure nerve tissue. The treatment of a growth near a large blood vessel by buried radon in gold seeds is now a safe procedure. The more even distribution of the filtered radiation permits of more adequate treatment without the necrosis of the vessel wall, hemorrhage into the surrounding tissue, and finally thrombosis of the vessel.

In the intraoral group of carcinomas, the advent of gold-filtered seeds has been an important advance in radiotherapy. Glass seeds, depending almost wholly on the caustic effect of beta radiation, caused wide-spread sloughing in areas treated. The blood supply of the oral region is profuse. It was therefore necessary to ligate the arteries supplying the treated area. This was necessary whether the necrotic mass was allowed to separate spontaneously or whether the condemned portion, together with some of the proximal viable tissue, was removed by cautery. Gold seeds may be implanted in new growths in the region of the nutrient artery, with little or no infection, no sloughing, and with no fear of hemorrhage. It is not necessary to limit the blood supply.

Gold seeds, though the same as platinum physically, are vastly superior mechanically, safer surgically, and the actual application is much less uncomfortable to the patient. They may be implanted where the use of platinum removable seeds is impossible.—*J. D. Camp.*

GELPI, M. J. Review of various methods of treatment of carcinoma of the cervix. *Radiology*, 1928, xi, 403–406.

Irradiation by deep therapy exclusively does not seem to be particularly well adapted to the treatment of cervical carcinoma, and so far, in this country at least, has not come into popular favor for this purpose. However, as an adjunct, deep therapy does have a definite field of usefulness, particularly in the control of metastases, extending over large areas. No statistics as to five-year cures by deep therapy alone were available.

Irradiation with radium, however, is especially suitable for the treatment of cervical carcinoma. On account of the high primary mortality and comparatively low five-year salvage, the last few years have seen many converts from the ranks of the surgeons, who have turned almost entirely to radium, except for the comparatively rare, early cases.—*J. D. Camp.*

GIBERT, PAUL. The roentgen therapy of tuberculous adnexitis. *J. de radiol. et d'électrol.*, April, 1929, xiii, 253–256.

Roentgen therapy is of paramount importance in the treatment of tuberculous adnexitis. While the operative procedures have a mortality of 8 per cent, roentgen therapy is entirely without danger. Furthermore irradiation can be applied even in the most severe cases where operation is contraindicated.

The irradiation consists in the application of fractional doses such as used generally for affections of tuberculous nature. Certain roentgenologists believe that only a temporary sterilization should be attempted but the

author is of the opinion that a permanent castration is of greater value (*a*) since technically it is easier to be carried out; (*b*) since the pelvic congestion associated with menstruation always leads to exacerbation of the tuberculous process, and (*c*) since pregnancy is not desirable in cases with tuberculous adnexitis.

The dose consists in the administration of 500 R per field, once or twice weekly (120 kv., 0.5 mm. Zn plus 1 mm. Al, 30 cm. skin target distance) until a total dose of 4000 to 5000 R is reached. Two to three months later the series is repeated.

Of 17 cases treated 3 died following other manifestations of the tuberculosis, 5 showed considerable improvement and 9 were permanently cured (duration of observation being from one to four years).

The conclusion is reached that irradiation should always be attempted in all cases of tuberculous adnexitis and that only the cases refractory to irradiation should be submitted to operation. In many instances an association of operative procedures with postoperative irradiation is of considerable value. Irradiations should be carried out with fractional doses until permanent menopause is obtained. Simultaneous dietetic and climactic treatment is indicated.—*T. Leucutia.*

Gragert, O. The question of bilateral roentgen castration. *Strahlentherapie*, 1929, xxxii, 293–302.

The series irradiated between Jan. 1, 1918 and Dec. 31, 1927, includes 338 cases of preclimacteric bleedings in women between thirty-eight and fifty-nine years of age. In 112 cases up to October, 1921, the average dose was 480 X per ovary, while in 226 cases treated since October, 1921, the dose amounted to 40 per cent S.U.D., and more recently to 105 to 164 R per ovary.

A permanent amenorrhea was obtained in practically 100 per cent of the cases, this indicating that the schematization of the castration dose as practised by Seitz and Wintz is not necessary. A gradation of the dose according to age (Gauss and Kadisch), however, is advisable in the cases under forty-five, although it appears that the roentgen sensitivity of the ovarian tissues depends, in addition to age, also on certain unknown physiological factors.

Due to the fact that artificial roentgen climacterium leads to symptoms more pronounced than the physiological climacterium, the author more recently introduced the unilateral roentgen castration according to Pape. Bilateral roentgen castration is thus reserved only for the unsuccessful cases.—*T. Leucutia.*

Grier, G. W. Surface applications of radium. *Radiology*, 1928, xi, 474–479.

When malignant disease is being treated, it is the author's belief that a full dose should be administered as quickly as the radium supply will admit.

The manner of distribution of the radium should be such that all parts of the surface treated receive the same dose. To accomplish this, equal units of radium should be so placed that the distance between units in both directions is one and one-half times the distance from the radium to the surface treated. In placing units at this distance apart, the skin directly beneath one unit receives approximately 25 per cent of a dose from each unit which is placed next to it in each direction. Therefore the effect of a unit entirely surrounded by similar units would be 100 per cent greater than it would be if only one area were treated by one unit. In a malignant lesion, the most vital part of the growth is at the edge and the edges should receive more and not less treatment than the center. Therefore this should always be kept in mind when placing the radium and a generous margin should be included in the area to be treated.

Theoretically, the filter should be chosen to correspond to the character and thickness of the lesion, but in practice the author has obtained better results, even in surface lesions, with brass filters than with aluminum or other easily penetrable filters. This may possibly be a question of dosage, as it is customary to leave aluminum-filtered radium in place a much shorter time than in cases where brass filters are used, on account of the more violent surface reaction in the lightly filtered radiation. However, the shorter application would appear to be the only advantage in the aluminum filtration. If it is necessary to leave aluminum-filtered radium in place the same length of time as brass-filtered radium, the latter is preferable because there is less escharotic effect. It would seem that whatever beneficial effect is possible from the use of radium can be obtained by the use of the harder beta rays and the gamma rays—possibly from the latter alone. The gold, lead, brass or other filter of heavy metal should always be covered with an additional filter which has the capacity to absorb the secondary rays emitted by the metal and which gives off no secondary rays of its own. The materials usually used for this purpose are soft pure rubber, hard rubber, or aluminum. If this secondary filter is not used,

a violent escharotic effect may follow, which serves no useful purpose and is painful and undesirable.

The action of radium is governed by the inverse square law in the same sense as are roentgen rays, and as the distance at which radium is customarily used is much less, the necessity of accurate measurement is proportionately greater. The ideal applicator holds the radium accurately at a known distance for the entire period of the application. For treatment over skin surfaces which are not too irregular in contour and where it is desirable to use the radium one-half inch or more from the surface, the author has found pith wood to make an ideal applicator. Its specific gravity is so low as to offer almost no resistance to the rays and it is rigid and therefore maintains the radium at a fixed distance.

For treatment in the mouth, the radium, covered by rubber tubing, may be fastened to the end of a strip of sheet lead and this inserted into the mouth and so bent that the radium comes in accurate contact with the lesion. The end of the strip of lead which projects from the mouth is bent around against the cheek and fastened there by adhesive and bandages.

For treatment of esophageal lesions, the author uses a gold filter which is coated with hard rubber. A flexible cable screws into the end of this filter. It holds 50 mg. of radium in needles. It can be placed in position through an esophagoscope and the cable is sufficiently rigid to hold it in position.

For treatment of the prostate intra-urethrally, the author has an aluminum sound with the curve of an ordinary urethral sound and a hollow tip in which 50 cm. of radium can be placed.

For carcinoma of the cervix of the uterus, 25 mg. units covered by rubber tubing and placed side by side to cover the lesion will be found satisfactory in most cases. Where the lesion involves the outside of the cervix and also extends up into the cervical canal, a special applicator which consists of two pieces is used.

Radium should never be applied in such a manner that the exact distance from the surface is unknown, such as wrapping it up in a piece of gauze, for instance. Gauze pads make poor applicators because they are compressible and the distance from the radium to the surface may be altered by the pressure from the adhesive or bandages which are used to hold them on.

In treating malignant ulcerations, a dose which produces tissue necrosis is used. On the other hand, birthmarks are usually given a little less than an erythema dose. In treating primary surface malignancies an attempt is made to produce complete destruction of the lesion at one application. Any areas which show evidence of vitality at the end of six weeks should receive another treatment. In treating lesions situated beneath healthy skin a single destructive dose is seldom if ever practical. If the lesion is malignant, the common practice is to give a mild erythema dose and repeat this every six weeks until the desired effect is produced. It is probably not safe to give more than four such treatments. As a matter of fact, the author doubts if there is ever any favorable response to treatment after this amount of radiation has been applied.—*J. D. Camp.*

Hubert, H. The question of unilateral roentgen castration. *Strablentherapie*, 1929, xxxii, 303–308.

Following Pape's method of unilateral roentgen castration the author treated 28 cases of preclimacteric menorrhagias in women between thirty-eight and forth-eight years of age. In 2 cases there was return of the normal menstruation, 20 cases became permanently amenorrheic and in 6 cases there were no results.

Contrary to Pape, who uses unilateral castration in women of all ages, the author advises the application of the method only in preclimacteric bleedings since good results in these cases are more readily obtained. In the refractory cases the successive roentgen castration of the opposite side is performed later.

The advantage of unilateral roentgen castration is that the climacteric symptoms are less severe and thus less inconvenient to the patient than with bilateral roentgen castration.—*T. Leucutia.*

Hueck, Hermann, and Spiess, Walter. The question of growth disturbances following roentgen irradiation in bone and joint tuberculosis. *Strablentherapie*, 1929, xxxii, 322–342.

Seventy-six cases of bone and joint tuberculosis treated by roentgen therapy were subjected to a detailed investigation with regard to the growth disturbances produced. In 15 cases there were no disturbances, in 60 cases there was growth inhibition (in 11 cases a difference in the circumference of the extremity, in 49 cases difference in the longitudinal and transverse growth of the bones), and in one there was growth acceleration.

The technique of irradiation between 1919 and 1922 consisted in the administration of ⅓ to ½ and occasionally 1 S.U.D. per sitting, with 0.5 mm. Zn and 1 mm. Al as filters,

while later due to the application of more penetrating rays, the doses were gradually reduced until 15 to 20 per cent S.U.D. was administered on the surface of the skin (15 to 25 per cent S.U.D. at the site of the lesion).

The opinion is expressed that the growth disturbances are the result of the secondary changes brought about by the tuberculosis and not due to irradiation. This opinion was reached on the basis (1) that a parallelism was observed between the degree of the growth disturbance and the degree of extension of the lesion; (2) that a marked destruction of only certain portions of the bones irradiated (as for example of the head of the different bones) was noticed in the roentgenogram of a great number of cases; (3) that similar disturbances appeared in cases only once or twice irradiated and later treated by plaster-of-Paris fixation, and (4) that other parts of the body distant from the lesion also presented like disturbances.

Two cases (given very severe doses of roentgen rays with resulting marked skin changes) are described in detail in which the effect of the roentgen rays on the normal development of the bone, however, cannot be denied.

The conclusion is reached that irradiation with small doses as practised nowadays in the treatment of bone and joint tuberculosis does not result in growth disturbances of the bones or joints irradiated.—*T. Leucutia.*

Liebersohn, J. The treatment of inflammatory diseases with small doses of roentgen rays. *Strahlentherapie*, 1929, xxxii, 356–360.

Two hundred and fifty cases of inflammatory diseases, one-third of which were acute cases, were treated by small doses of roentgen rays in 1927 and 1928. In 75 per cent of the cases good results were obtained. The technique used was as follows: 120 kv., 23 cm. skin target distance, 0.5 to 1 to 2, rarely 3, mm. Al, ½ to 1 to 2 H in superficial lesions, and 180 kv., 0.5 mm. Zn and 1 mm. Al in deeper lesions.—*T. Leucutia.*

Puschin, B., and Kordatova. L. Roentgen therapy of scleroma of the upper air passages. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 679–684.

Forty-seven cases with scleroma of the upper air passages have been treated during the past four and a half years. Eighteen cases were clinically healed (no recurrence two or three years later); in 25 cases there was a marked improvement and in 4 cases there was no improvement.

The technique of irradiation during this period has been changed several times but the basic principle has remained the same: small doses are used over the nasal cavity and larynx with rather heavy filtration. The latest technique is described as follows: ½ S.U.D., small fields 6 × 8 cm., 24 cm. skin target distance, zinc and copper filters, 180 kv., one field over the nose and a second field over the sternum. Two additional fields are given over the larynx by using rays of 100 kv. filtered with 3 mm. Al. The four fields are given over a period of four days, treatment being repeated not sooner than two months. An average of five to seven series is applied.

The conclusion is reached that roentgen therapy is the method of choice in the treatment of scleroma of the upper respiratory tract.—*T. Leucutia.*

Rosenberg, L. Charles. Roentgen treatment of acute cervical lymphadenitis. *Am. J. Dis. Child.*, March, 1929, xxxvii, 529–540.

Rosenberg reports 80 patients with acute cervical lymphadenitis treated by roentgen irradiation. All these patients were children, under seven years of age, and the disease was secondary to infections of the upper respiratory tract. Cases included were not due to buccal infection, carious teeth, scalp infections, eczema, retropharyngeal abscess, tuberculosis of the glands or to infectious mononucleosis. Inflammation occurred invariably in the superior deep cervical nodes. All cases selected for the series were considered potentially suppurative, mild cases being excluded. No auxiliary treatment was used, reliance being placed entirely on irradiation as a therapeutic measure.

Minimal doses were found essential. Average dose given was 20 per cent of one skin unit dose on the surface, with the use of from 150 to 180 kv., 0.5 mm. zinc or copper plus 3 mm. aluminum as filter, and a focus skin distance of 30 cm. This dose was equivalent to 260 R units, one skin unit dose being equal to 1,300 R. The surface treated was always larger than the area of inflammation. As a rule, the younger the child, or the more acute the inflammation, the smaller was the size of dose given. When required, a second treatment was given after an interval of five to seven days.

Twelve patients developed suppuration. In the remaining cases, in 85 per cent the inflammation completely subsided without surgical intervention. No unfavorable result from treatment was noted in any case. As a general rule, if the patient received treatment by the third or fourth day of the disease the inflammation subsided. Roentgen treatment not only accelerates the local inflammatory process but relieves pain and discomfort.

Both local and general affects have been claimed from roentgen treatment.

Summary. 1. Roentgen therapy has been used with good results in a variety of acute infections as histologic evidence has demonstrated. Its use is warranted, therefore, in the treatment of acute cervical lymphadenitis; 80 patients were treated, 68 recovered without suppuration.

2. Acute cervical lymphadenitis is almost always of prolonged duration. Roentgen irradiation accelerates the inflammatory process, so that there is either rapid resolution or rapid breaking down.

3. Following the exposure there is relief of pain and discomfort and improvement in constitutional symptoms.

4. Unfavorable effects do not result from irradiation.

5. Roentgen therapy, though it reduces the need for surgical intervention to a minimum, cannot supplant it.

Rosenberg considers irradiation to be the most successful treatment for acute cervical lymphadenitis. The earlier the treatment is given, the better is the result.—*R. S. Bromer.*

SCHMITZ, HENRY, and HUEPER, WILLIAM. The prognostic value of the histological malignancy index and the clinical grouping of carcinomata of the uterine cervix. *Radiology*, 1928, xi, 361–369.

The prognosis of a carcinoma depends upon numerous factors. These may be inherited or acquired, permanent or transient, local or general. The factors may be considered under five divisions:

1. The degree of the histological malignancy of a carcinoma as represented by the infiltrative, destructive, and histologic qualities of the tumor cells and of the stroma. The factors form the basis of the histological malignancy index.

2. The extent of the tumor depends to some degree on the duration of the disease and the infiltrative intensity of the growth. It forms the basis of the clinical grouping.

3. The endogenous carcinolytic power and protective resistance of the host, which probably depends on age, race, sex, constitution, heredity, and so forth. These factors have been investigated to some extent by one of us.

4. Exogenous factors, that is, the chronic irritation produced by external agencies, such as tar, paraffin, aniline dyes, radiations, chemicals, bacteria, parasites, trauma, and so forth.

5. Secondary complications by the neoplasm. They are: (*a*) Mechanical causes, as pressure and obstruction of glandular ducts, ureters, intestines, esophagus, etc.; (*b*) secondary infections of the tumor and surrounding tissues, which decrease general resistance and may prove fatal; (*c*) toxemias from resorption of toxic products of necrotic tumors.

The "histological malignancy index" and the "clinical group" are important aids in the prognosis, and the surgeon and radiologist should consider them in choosing the indicated method of treatment. A clinical Group 4 carcinoma and a carcinoma with a histological malignancy index of 68 or higher give each an infaust prognosis. Such cases should not be subjected to a needless operation or useless radiation treatment. The parallelism of the graphs of the percentages of the five-year end-results and the malignancy index groups is convincing evidence of the value of such grading.

Short wave roentgen therapy has increased the five-year cures in clinical Group 3 to 18.65 per cent, while with long wave technique they were 9.21 and 7.69 per cent. Radium rays cannot effectually arrest a carcinoma in the parametria or at the bony pelvic girdle, the seat of the regional lymph nodes.

The recurrent carcinomata numbered 138 with 5 five-year good end-results in Group R1, or 50 per cent—an absolute cure of 5.79 per cent of the entire number. Unless recurrences are local and movable, i.e., belong to Group R1, a good end-result cannot be expected from radiation treatment.—*J. D. Camp.*

SCHREINER, BERNARD F. Radiation effects on systemic aleukemic lymphomatosis. *Radiology*, February, 1929, xii, 127–135.

Four cases of "systemic aleukemic lymphomatosis" observed by the author are reported in detail. The blood pictures in all showed a normal, or slightly lower or slightly increased total, leucocyte count, with an absolute lymphocytosis differentiating these cases from the leucemias and the lymphogranulomas.

Two cases showed hematological pictures of aleucemic leucemia and subsequently chronic leucemic blood findings. Radiation in sufficient quantity, from 30 to 65 per cent of the skin erythema dose, caused a disappearance of the enlarged tumor masses or nodes. The radiation in these cases must be controlled by blood counts, and a disastrous leucopenia must be anticipated.—*J. D. Camp.*

SOILAND, ALBERT, COSTOLOW, WILLIAM E., and MELAND, ORVILLE N. Comparative notes on radon implants. *Radiology*, January, 1929, xii, 45–47.

The great advantage of the filtered implant

is due to the fact that a sufficient amount of radium is used to irradiate thoroughly the periphery of the lesion, and at the same time serious local necrosis is avoided by the metallic filtration.

Correct estimation of the size of the growth is undoubtedly the most important factor in the consideration of the use of radon implants. The older method of using one millicurie per cubic centimeter of malignant tissue, and spacing the tubes one centimeter apart, often caused either overdosage or underdosage. However, even with the most accurately calculated dosage and spacing of the implants, it is not always possible to obtain the desired result, as certain factors are difficult to overcome. The radiosensitivity of the tumor probably determines to a great extent the subsequent reaction and ultimate outcome.

Mechanically, it is often impossible to obtain an even distribution of the points throughout the malignant tissue. Proper spacing is of more importance than the total amount of radon used, especially in the use of filtered radon.

The question of choice between the buried gold implants and the removable platinum points is difficult to decide. In accessible areas gold implants are the method of choice. However, the authors favor the removable implants in the mouth and in other accessible anatomical locations. Infection or complications very seldom develop from use of the removable points if they are withdrawn within a ten-day period. In all implant work the possibility of future late reactions must be borne in mind. The local action of the radiation on the blood supply of the area treated may cause later trouble.

The metallic implants seem almost ideal in the tongue, floor of the mouth, and the inner surface of the cheek. In lesions of the palate, however, a better ultimate result will be obtained by electrocoagulation.

In bladder malignancies, filtered implants appear to be the best form of radium therapy. In small lesions, the implants may be applied directly to the lesion through a cystoscopic applicator, but as the extent of the bladder lesion may be difficult to determine, or it may be multiple, suprapubic cystotomy with implantation alone, or combined with electrocoagulation, is probably the method of choice.

Rectal malignancy will undoubtedly respond better to metallic implants applied directly to the lesion through the proctoscope than to any other method of treatment. In the smaller lesions in the lower rectum, the application may be made as accurately and easily as in superficial lesions elsewhere.

The authors used radon seeds in malignancy of the cervix in only a few cases, believing that this condition can be treated more safely, and with less chance of bladder and rectal injury, by using the ordinary brass filtered tubes, as advocated by most radiologists.—*J. D. Camp.*

Talia, Ferdinando. Roentgen treatment of penetrating ulcers of the lesser curvature. *Radiol. med.*, Jan., 1929, xvi, 21–35.

After a short review of the literature dealing with results of roentgen therapy in gastric and duodenal ulcers in general, the author presents 4 cases of penetrating ulcers of the lesser curvature which were treated by irradiation. Although there was a marked improvement in the clinical symptomatology following the application of roentgen therapy, check-up examinations by means of a barium meal failed to reveal a corresponding improvement in the condition of the ulcer.

Since the roentgen appearance of the ulcer remained practically the same during the entire course of the examination, it is probable that the amelioration was due to the change in the gastric secretion rather than to the healing of the ulcer.

The technique of irradiation was as follows: fractional method with weekly applications of ¼ S.U.D. for four to five treatments. After an interval of two months the series was repeated. In 2 of the cases large fields (10 × 15 cm.) and in 2 others small fields localized to the abdominal projection of the ulcer were used. It is interesting that the results have been more satisfactory in the cases with small fields.

The conclusion is reached that though no anatomical healing of the ulcer was observed following roentgen therapy, the clinical improvement was so marked that roentgen therapy is to be considered as an important agent in the treatment of penetrating ulcers of the lesser curvature.—*T. Leucutia.*

v. Wieser, W. Further experiences with roentgen therapy in psychiatric and neurologic diseases. I. Mongolism. *Strahlentherapie*, 1929, xxxii, 215–292.

In estimating the value of roentgen therapy in psychiatric and neurologic diseases mongolism was chosen since (1) it forms a condition which can easily be treated; (2) it is fairly commonly known; (3) it is very well defined; (4) its course without treatment is characteristic; (5) its course following medication is accurately established, and (6) a comparison of treated and untreated cases is easily accomplished.

The series includes 46 cases (of from six months to 18½ years of age), 28 of which

received roentgen therapy by the author, 2 were treated in another institution and 16 were not treated. Of the 16 untreated cases 6 were followed up for a longer period and they were used as controls. The observation in the treated cases lasted for a period of from eight months to 3⅔ years, with an average observation time of seventeen months (while the average observation period for the controls was twenty-six months).

The technique of irradiation was as follows: 5 fields 6 by 8 cm. over the skull, 30 cm. skin target distance, 180 to 200 kv. maximum, 0.5 mm. Zn plus 1 mm. Al as filters, 5 to 10 per cent S.U.D. per field, repeated twice weekly. In younger patients only one field was administered every two weeks and in some instances every four weeks. The series was repeated at four, later at six, eight and ten weeks' intervals for three to six series. In infants an irradiation of the entire head was performed in one sitting from 2 meter skin target distance, 2 per cent S.U.D. having been given at every four week interval. In many cases roentgen therapy was combined with organotherapy.

The 46 cases are described more or less in detail.

In analyzing the results obtained special attention is paid to the following signs: (1) Height and weight. It was found that there was a considerable increase in both height and weight in the irradiated cases as compared to the control cases. The average yearly growth of the treated cases was 5 cm., while the untreated cases showed an average of only 2.5 cm. The difference between the treated and untreated cases was especially marked in children where the yearly growth has amounted to 9.6 cm. The weight curve following irradiation has approached that of normal individuals while in the untreated cases there was a rapid diminution in weight especially following the age of thirteen. (2) Microcephalia. This sign remained entirely uninfluenced by the irradiation. (3) Flattening of the face. Of 22 cases with flattening of the face, in 5 cases a marked improvement, in 10 others a slight improvement and in 5 no improvement was noted (2 cases were not located). (4) Slit eyes and slanting eyes. Of 18 cases with slit eyes, in 4 there was a very marked improvement, in 11 a slight improvement and in 2 there was no improvement (1 case not located), while of 21 cases with slanting eyes, in 2 there was a very marked improvement, in 10 a slight improvement and in 7 no improvement (2 cases not located). (5) Epicanthus. Of 19 cases with epicanthus, in 5 cases there was a complete disappearance of the symptom, in 10 cases there was a marked improvement and in 2 cases there was no improvement (2 cases not located). (6) Conjunctivitis eczematosa. This sign was observed in only 10 cases, in 5 of which the conjunctivitis entirely disappeared following the irradiation, while in 4 there was a marked improvement and in only one was there no improvement. (7) Flushed cheeks. This sign also showed a disappearance in over 50 per cent of the treated cases. (8) Lingua scrotalis. Only 11 of the treated cases showed evidence of lingua scrotalis, 5 of which improved and 6 remained uninfluenced following irradiation. (9) Deep voice. This sign was observed in 16 of the treated cases, in 5 there having been a complete disappearance, in 8 a marked improvement and in 3 no improvement. (10) Small nipples and umbilical hernia. In neither of these signs was there any improvement following irradiation. (11) The appearance of different ossification centers as shown in roentgenograms. The results obtained here in the treated and untreated cases were so varied that no conclusion could be reached. However, the shortening of the fifth finger which appeared in 21 of the treated cases showed in 4 cases a return to normal and in one case a marked improvement (16 cases remaining uninfluenced and one case not being located). (12) Psychic improvement. The general impression was that a marked improvement in the intelligence as well as in the anxiety followed irradiation.

The conclusion is reached that roentgen therapy with mild doses is of considerable value in mongolism. The question of dosage however is not to be considered final. Further investigations will be carried on by treating additional cases with varying doses. A literature of 78 references is appended.—*T. Leucutia.*

MISCELLANEOUS

Burby, John J., and Barry, M. W. Comparative measurements of the quality of roentgen rays. *Radiology*, 1929, April, xii, 275–282.

The quality of radiation produced by two types of roentgen-ray apparatus was studied; two different models of each type were available; three dosimeters, two with large ionization chamber and one with a thimble chamber, served as measuring instruments.

The values obtained on the mechanical rectifier machine agree well with those reported by Pohle and Barnes. The penetration of the radiation produced by a kenetron apparatus does not differ markedly for potentials below 150 kv. If higher potentials are used, there is a definite increase in the penetration as compared

with the mechanical rectifier machines. The filter thickness required for obtaining homogeneous radiation is less for the kenetron apparatus.

The intensity of the radiation produced by the kenetron machine is higher if compared on the basis of equal quality of radiation, as well as for equal potential and filter thickness.—*J. D. Camp.*

Burrows, M. T., Jorstad, L. H., and Ernst, E. C. The chemical and biological changes induced by x-rays in body tissues. *Radiology*, 1928, xi, 370–378.

The authors give the evidence to date showing that one of the actions of roentgen rays on the tissues is to remove their normal lipoid content. It is shown also that one of the chief actions of roentgen rays in destroying cancer is by the removal of these lipoids, not only from the cancerous tissues, but also from the normal tissues immediately adjacent to them. These lipoids are necessary substances for the growth of the cancer cells. Without them, the cancers degenerate quickly.—*J. D. Camp.*

Coyon, A., and Brun, C. Experimental reproduction of the lesions of Hodgkin's disease. *Bull. et mém. Soc. méd. d. hôp. de Par.*, Jan. 28, 1929, liii, 82–85.

Coyon and Brun twice obtained by direct inoculation and by injection into the veins of guinea pigs, of fragments of a mediastinal tumor removed from a typical case of Hodgkin's disease, the reproduction of the characteristic histological pictures upon which the diagnosis of human granulomatosis (Hodgkin's disease) is based. This fact seems to be an argument, but without proof, in favor of the rôle of a transmissible virus by way of the blood stream, in the causation of Hodgkin's disease. In the published discussion of this paper, Tixier suggested that inasmuch as granulomatous lesions, resembling tubercle formations without Koch's bacilli, were reported in these guinea pig lesions, it would seem wise to await later report of such reproduced lesions which were not associated with tubercle formation, and so rule out the possibility that the tubercle bacillus had played any part in the formation of the lesions reported.—*R. S. Bromer.*

Dauvillier, A. Generation, roentgenologic application and measurement of roentgen rays of long wave length (up to 8 Å). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1929, xxxix, 670–678.

The glass of the usual roentgen tube consists of a compound of sodium-calcium-silicate which in a thickness of 0.7 mm. as used for most roentgen tubes absorbs all roentgen rays longer than 1.2 Å. Bucky, by making use of the Lindemann glass window (in which silicium is replaced by borium, sodium by lithium and calcium by beryllium) succeeded in generating roentgen rays of a wave length between 1.2 and 2.0 Å, which he called borderline rays. The author has tried to produce roentgen rays of still longer wave length by replacing the Lindemann window with some other less absorbing material. From Miller's experiments on the absorption of borderline rays by aluminum, celluloid and gelatin, it was found that the equivalent thickness of the gelatin for rays of 5 Å (2.5 kv.) would be 0.023 mm. Since cellophan has the same penetrability, but is more suited for practical manipulation, the author decided to use cellophan for the construction of the window of his new tube. On the other hand, since a heating up of a tube provided with a cellophan window (for the purpose of producing a vacuum) would lead to damage to the cellophan, the author found it necessary to supply the tube with a permanent pump operating during the actual run of the tube.

The construction is as follows: The copper anticathode which is of a conical shape and which has a circular water coat for cooling purposes, is provided with an arrangement for the exchange of discs of different material (Mg, Al and Fe) serving as anticathode surfaces. The cathode is practically the same as that of a Coolidge tube with the exception that the filament is placed between two parallel metal discs so as to permit a larger dispersion of the electrons thus reducing the density of their beam. The window consists of 0.02 mm. cellophan which is first washed (for the elimination of the glycerine) and then coated with alcoholic shellac (0.005 mm. thick) so as to protect against dampness. The tube is connected to a permanent vacuum pump which is either a molecular or mercury vapor pump.

Measurements made by means of the Szilard electrometer revealed that roentgen rays are generated already beginning with 1 kv. max. (12 Å), but that a monochromatic radiation suited for practical application is reached only with 3 kv. (7 Å). When using Fe as anticathode and a filter of 0.12 mm. cellophan as window and exciting the tube with 10 kv., a homogeneous beam of Bucky rays (2 Å) is obtained. The absorption of the rays from 3 to 8 Å was determined by means of the Szilard electrometer both for air and cellophan, and it was found that the intensity of the soft rays is reduced to half by 1 mm. air or 0.02 mm. cellophan. Aluminum of similar thickness

(0.02 mm.) would reduce the intensity of the beam fifty times.

The most characteristic features of the roentgen rays of very long wave length are: (1) that they produce a fluorescence of the usual screens showing an increasing luminescence from barium-platinum-cyanide to willemit and zinc sulphur. The latter shows an especially marked luminescence when using a Wehnelt cathode and 0.02 mm. thick black cellophan window; (2) that they have a marked tolerance for the skin, a rather large dose being necessary to order to produce a mild erythema which as a rule is followed by a pigmentation lasting for over a month. The range of the individual tolerance of the skin is much greater than with the usual roentgen rays, a guinea pig irradiated with a large dose failing to show either radiodermatitis or epilation; (3) that various forms of chronic eczema of the hands and psoriasis which remained recalcitrant to medical treatment and which have failed to respond to treatment with Bucky rays and ultraviolet irradiation (3660 to 3345 Å) showed prompt healing.

Although the experiments are still in their infancy there can be no doubt that the roentgen rays of very long wave length form an important addition to the roentgen and ultraviolet ray treatment of various conditions. —*T. Leucutia.*

HENDERSON, M. S. Fractures from an operative viewpoint. *Radiology*, March, 1929, xii, 214–223.

The author lists the recent closed fractures most satisfactorily treated at the Mayo Clinic by some form of open method, as follows: In the lower extremities—Astragalus, if there is marked displacement; Pott's fracture, if the malleolus is broken off high and well into the articular surface of the tibia; refractory fractures of the ankle with spiral fracture of the fibula, broken internal malleolus, etc.; oblique breaks of the lower third of the tibia and fibula; patella; shaft of the femur in the adult, particularly in the lower third with posterior displacement of the lower fragment; fracture dislocations of hip; slipped epiphysis in the upper end of the femur in children (should be operated on early). In the upper extremities—Overriding fractures of metacarpals; badly comminuted fractures of scaphoid; most fractures of the shaft of both ulna and radius; lower third of radius (other than typical Colles); head of radius; olecranon process; fracture or epiphyseal separation of the lower end of the humerus in children; particularly if the lower fragment is displaced anteriorly; surgical neck of humerus with overriding; fracture dislocations of the head of the humerus. Henderson goes on to say that the open method is being used more and more, but it should be employed only by those who are properly qualified and in proper surroundings. The use of the open method as a routine is not advocated. Whenever possible the conservative method should be used.—*J. D. Camp.*

HICKEY, P. M., POHLE, ERNST A., LINDSAY, G. A., and BARNES, J. M. Skin toleration doses in roentgen units and their relation to the quality of radiation. *Radiology*, April, 1929, xii, 309–316.

The measuring of the effective wave length (Duane) is proposed as a quality factor for practical purposes in radiology. It is necessary to always indicate the potential, the filtration, and the transmitting material used in the test.

Further studies of the relation between skin toleration doses in roentgen units and their relation to the quality of radiation have confirmed previous investigations of the authors. It seems safe to assume that small areas (3 cm. × 3 cm.) may be exposed to 500–600 R (primary energy) with all types of roentgen rays used in practice. The authors examined a range from lambda effective equal to 0.61 Å (60 kv., no filter, through 2.0 mm. Al) to lambda effective equal to 0.138 Å (200 kv., 1.0 Cu filter).

Caution should be exercised in transferring these results to the exposure of large fields in daily practice, because of the fact that there exists no simple method of measuring the exact amount of back-scattering on the patient.—*J. D. Camp.*

HOLTHUSEN, H. The biological aspects of roentgen therapy. *Radiology*, January, 1929, xii, 35–43.

Ultraviolet rays and especially the roentgen rays owe their great biological effect to the magnitude of their single quanta. In the field of roentgen rays a single quantum is even 25,000 times greater than in the ultraviolet zone. Therefore, there is a great disproportion between this enormous quantum-energy and the energy capable of being absorbed by each single molecule. In consequence, by far the greater part of the energy of the roentgen rays passes over during the process of absorption to the photo-electrons, and these it is which, in their turn, give off their energy in partial amounts, together with a slowing-down of their speed, thereby producing, amongst others, biological reactions in the tissues.

The energy of the roentgen rays is absorbed, not only during the above described process, but also during the scattering process by the

scattering molecule. The recoil-electrons carry also an amount of superfluous energy, exceeding more or less the capacity for absorption of the scattering molecules, according to the Compton law. The energy directly received by the absorbing molecule falls far behind the energy given to recoil- and photo-electrons; therefore, the roentgen-ray effects are to be looked upon as the effect of electronic radiation. In comparing the effects of roentgen rays and of light, it is of the greatest importance that, in the case of light rays, only the primary quanta of radiation are effective, while, on the other hand, in the case of roentgen rays, photo- and recoil-electrons are responsible for the biological effect.

Light supplies always distinct amounts of quantum energy. On the other hand, the electrons produced by the roentgen rays give off any amount of energy for absorption by the tissue molecules. In a word, this means: *specific* effect, i.e., dependence of the effect on the wave length in the case of light; *unspecific* effect, which is an effect independent of the wave length in the case of roentgen rays.

With regard to the field of roentgen rays, it is not possible to make a diagram showing the preferred effect of certain wave length zones in connection with biological reaction, as is shown in ultraviolet light. There is great monotony in the effect of different wave lengths in the field of roentgen rays. It may be stated with considerable probability of truth that all the effects of rays which have been observed are absolutely independent of wave lengths. One is not dealing with effects of sharply defined quanta of rays, but with radiation quanta, the energy of which may be disposed of in any desired amount. Accordingly, the effect of the short wave rays on cells is unspecific.

The wide variation in the sensitiveness to roentgen rays in various kinds of cells, which has led to a misunderstanding regarding the electivity of the cells, exists equally for all qualities of cells. There is no change of electivity of the sensitiveness to rays in connection with the wave length, and where it has apparently been found observers have been deceived by the great influence of the above mentioned penetrative effect, meaning the change of the distribution of intensity in an irradiated body owing to a change in the absorption coefficient with the voltage. The great difference in penetrative power between the softest and hardest therapeutically employed roentgen rays influences the distribution of intensity of the rays in the tissues and is of very considerable influence on the way in which the radial reaction is manifested. It cannot be denied that the reaction of the skin takes an exceedingly different course in the supersoft roentgen rays used by Bucky and the hard filtered rays of deep therapy. In the case of very soft rays of a medium wave length of 5000 Å., one can multiply the dose, already producing a severe erythema, without essentially altering the type of reaction. If hard filtered rays were used, this increase in the dose would lead to the severest burns. It would seem at the first glance that there was a difference in the graduation of the effect of the roentgen rays, yet it is only proof of the fact that in the case of very soft roentgen rays the effect is limited to the topmost epidermic layers. Hard roentgen rays are absorbed almost in the same quantity in all epidermic layers. The increase of the dose in the cutis leads to an injury of the connective tissue cells and blood vessels, thus preventing the necessary nourishment of the irradiated area of skin, and causing slough.

The difference in the distribution of the effective dose in the skin in the case of soft and hard roentgen rays explains also the difference in the interval of time which must be allowed to elapse before the skin will have entirely recovered from the impact of the rays. If the epidermic layers themselves are chiefly affected, one has to deal with a tissue which is physiologically being rapidly regenerated and which, compared to the cells of the cuticle and the endothelial cells of the vessels, has an increased cycle of life. It is characteristic that the intervals of time which must elapse between two full dose irradiations must be greater, as harder rays are used. The period of recovery lasting three weeks which was prescribed for the treatment by means of unfiltered rays has caused great disappointment, if also used after a full dose of hard filtered rays. The longer time of recovery of the tissues which has been observed in the skin after treatment with harder rays, is, therefore, not an essential characteristic of the corresponding rays, but is produced by the difference in penetration. The assumption of a uniformity of the biological action throughout the whole range of the roentgen rays greatly simplifies the answer to the question regarding the nature of the injuries. Knowledge of the first changes caused by the rays is still very limited. There is, however, good reason for the opinion that the first attacks by the rays take place in the albumin molecules. This opinion would appear to be supported by the fact of the great similarity between injuries caused by rays and by heat.

The destruction of albuminous molecules by radiation means also the formation of

pharmacologically effective disintegration products. The products of destruction arising from the disintegration of the high molecular bodies, whether they have been formed by means of a photolytic process or later in the course of a secondary following process, affect the cell in which they are formed. They affect their surroundings and the whole organism by entering into the circulation. The circle of radial reactions responsible for the effect of the highly molecular disintegration products becomes more and more extensive. In the course of the last few years marked parallels have appeared between the general effects of the roentgen rays and the effects of the protein bodies. Common to both is an "Umstimmung" of the organism, which manifests itself in an alteration of the salt content of the tissues and the blood, in a "transmineralization" (Kroetz), in a transmutation of the albuminous bodies in the blood plasma, and in a number of other humoral and cellular blood changes, as is characteristic for the effect of high molecular albuminous products.—*J. D. Camp.*

Lacassagne, A. The direct and indirect action of radiation on cancer tissues. *Radiology*, 1928, xi, 393–402.

Following the experiments of Kok and Vorlaender, which apparently establish the fact that a weak dose of radiation administered to the body as a whole is much more effective than a strong dose received by the tumor, general irradiations have been tried. So-called stimulating radiotherapy of the spleen or different glands has been combined with local irradiation. It does not seem as if these trials have furnished convincing results in human therapy. Opitz has called attention to certain cases in which the tumor has disappeared after very small doses and other cases in which cancer cells have persisted in the midst of a connective tissue destroyed by excessive irradiation. The difference in radiosensitivity of the many varieties of malignant tumors suffices to explain these apparent contradictions.

The author gives the following conclusions:

1. Three principal theories have been maintained to explain the destruction of cells under the influence of radiation: (*a*) a direct action, (*b*) a local indirect action, (*c*) an indirect general action.

2. This problem can be regarded as solved in so far as it concerns the normal elements. Radiation exercises its elective effects directly on the cells, and the indirect action is no longer considered, even by those authors who admit it only as an accessory phenomenon.

3. So far as pathological tissues are concerned and especially cancer cells, the problem presents itself under more obscure conditions.

The many experiments undertaken with transplantable rat or mouse tumors with the idea of showing an indirect action have, for the most part, been contested; even if they were all recognized as sound, serious objections could still be opposed.

4. Clinical teaching and the results of therapy lead us to believe that, in cancer, as in normal tissues, radiation acts by damaging the cells directly and electively.

5. If the goal of the radiotherapy of malignant tumors should, above all, be the destruction of the neoplastic cells, the importance of preserving the general tissues should not be forgotten. By attaining these two objectives we follow a line of attack formulated long since, which seems to be the most important condition for success: to administer to all the cancer cells the strongest dose compatible with the integrity of the healthy tissues.—*J. D. Camp.*

Laurens, Henry, and Mayerson, H. S. The measurement and specification of radiant energy. *Radiology*, April, 1929, xii, 328–340.

This is a comprehensive and technical discussion of the various methods of measuring radiant energy. The authors urge that radiant energy used for biological or therapeutic purposes be measured and specified in absolute units.—*J. D. Camp.*

MacCarty, W. C. The cancer cell in the practice of medicine. *Radiology*, 1928, xi, 379–387.

One thousand six hundred eighty-three gastric specimens resected or excised for chronic ulcer and for cancer were studied from the standpoint of relation of the size of ulceration to the amount of malignant involvement. In this series it was found that the average diameter of cancer of the stomach with lymph node involvement (516 specimens) was 4.47 cm.; that without lymph node involvement (298 specimens) it was 4.19 cm. During the making of diagnoses and records it was occasionally necessary to call some "early carcinoma," by which is implied the presence of secondary cytoplasia and a few malignant cells in the stroma of the mucosa. There were 46 such instances and all were chronic ulcers. The average diameter of these early cancerous ulcers was 2.17 cm. There were 39 ulcers in which only secondary cytoplasia was present; the average diameter was 1.4 cm. During this same period 784 simple chronic ulcers were excised or resected for diagnostic as well as

therapeutic purposes. It was impossible to be certain clinically that cancer was not present. The average diameter for the simple ulcers was 1.42 cm. If secondary cytoplasia is the immediate precancerous condition or even cancer in its early stages, then it would be natural to find it in simple chronic ulcers when they are still under the average diameter of 2.17 cm.

During the same period 2267 specimens of cancer of the breast and of chronic mastitis with secondary cytoplasia were studied as to size of the involved portion. The average diameter of mammary cancer with lymph node involvement was 2.35 cm. and without lymph node involvement, 2.13 cm. There were 21 cancers less than 1 cm. in diameter with no lymph node involvement and 5 less than 1 cm. with lymph node involvement. As in the study of cancer of the stomach, certain specimens were called "early carcinoma." There were 11 such specimens and the area of chronic mastitis containing the cancer had an average diameter of 1.7 cm. The areas in chronic mastitis designated as showing secondary cytoplasia (17 specimens) had an average diameter of 0.92 cm. The smallest typical cancer of the breast observed by the author was less than 2 mm. in diameter. There is a suggestive sequence in both series, especially so since in 12.5 per cent of the cases of "early carcinoma" of the stomach the patient died of recurrence within the period of eleven years. None of the patients suffering from secondary cytoplasia in the stomach are known to have died of cancer, but 7.5 per cent are known to be dead of unknown cause. None of the patients suffering from "early carcinoma" and secondary cytoplasia in the breast have died of recurrence so far as can be determined.

The malignant cell, which is itself a parasite, has just as definite a place in the practice of medicine as the bacillus of tuberculosis or the *Spirochaeta pallida;* and, whenever a practitioner is dealing with any chronic local ulceration or tumefaction, its presence must be ruled out if the disease does not become healed or disappear in a few weeks. This is especially true in the absence of foreign bodies, tuberculosis, syphilis, actinomycosis, blastomycosis, and perhaps some rare skin diseases. The affected area or mass should be excised, if possible, for diagnostic purposes. If the malignant cell is in the stroma, a radical operation with regional lymphadenectomy should be performed, provided the immediate operative risk is not too great. If the characteristic cell is found only in the tubules or acini and not in the stroma, then wide local removal is the only necessary procedure with our present knowledge. All such cases should be followed, however, for the possibility of recurrence.—*J. D. Camp.*

Mutscheller, A. The quality average of the continuous *x*-ray spectrum. *Radiology*, April, 1929, xii, 283–289.

The advantages of average wave length determinations are summarized by the author as follows:

Increased accuracy, by excluding the errors possible when only two determinations are made—errors in the metal thickness, leakage of the instrument, non-constant absorption coefficient. The average wave length can be read for thinner filters along the part where the absorption curve is bent, and with values obtained, which are in definite relation to the depth doses. From the point where the absorption curve becomes a straight line it indicates what minimum filter thickness will produce adequate filtration for best depth doses. The absorption curve gives valuable information as to the adjustment of mechanical rectifiers, gassy condition of the roentgen-ray tubes, or other errors which usually are not so easily detected.

Several interesting curves relating to average wave lengths and depth dosage are shown.—*J. D. Camp.*

Nasta, M., Jovin, I., and Blechmann, M. Diminution of the tuberculin sensitivity in tuberculous guinea pigs submitted to roentgen irradiation. *Compt. rend. Soc. de. biol.*, April 8, 1929, c, 906–908.

In a previous communication proof was brought that tuberculous guinea pigs submitted to ultraviolet irradiations develop a notable diminution of the tuberculin sensitivity both with regard to local and general reaction. In the present communication the action of roentgen rays on the tuberculin sensitivity of the tuberculous guinea pig is studied.

Six guinea pigs inoculated (Aug. 22, 1928) with 0.001 mg. bovine tubercle bacilli, Vallée strain, were submitted to roentgen irradiation in three sittings, (Aug. 23 and 24, and Sept. 5). The conditions of irradiation were as follows: Gaiffé, Gallot, Pilon continuous tension apparatus, A.E.G. tube, 150 kv., 4 ma., 23 cm. skin target distance, 6 mm. Al, single field of 4 × 7 cm. over the left lateral abdomen, 8 to 10 min., 7 to 8 H (Holzknecht pastille). Five days (Aug. 28) following the first irradiation the intradermal tuberculin test was done in one guinea pig both on the side irradiated and on the opposite side (a guinea pig inoculated at the same time and with the same

dose but not irradiated being used as control). Thirteen days after the first irradiation two other guinea pigs were submitted to the same tests. In all instances there was a diminution of the tuberculin sensitivity which was confined not only to the skin of the irradiated area but was generalized over the entire surface of the body.

Twenty days (Sept. 12) following the first irradiation 4 of the irradiated guinea pigs were injected intraperitoneally with tuberculin (2 animals with 0.2 c.c. and 2 with 0.5 c.c.) and were compared with 4 controls inoculated and injected at the same time and with the same dose but without being irradiated. All irradiated guinea pigs developed a rather violent reaction which however rapidly subsided (the elevation of temperature not being over 1°C.), the animals remaining alive. In the control guinea pigs the thermic reaction was over 2°C. and with the exception of one guinea pig (injected with 0.2 c.c.) all animals died within four, six and twenty-one hours.

The conclusion is reached that roentgen irradiation produces, in a manner similar to that of the ultraviolet irradiation, a diminished tuberculin sensitivity of the skin as well as a diminished general reaction of the entire organism resulting in increased resistance of the guinea pigs towards tuberculous infection.—*T. Leucutia.*

NASTA, M., JOVIN, I., and BLECHMANN, M. Variation in the number of leucocytes and in the leucocytic formula of tuberculous guinea pigs submitted to roentgen irradiation. *Compt. rend. Soc. de biol.*, April 8, 1929, c, 908–910.

In a previous communication the modifications of the leucocytes and of the leucocytic formula of tuberculous guinea pigs submitted to ultraviolet irradiation were studied. In the present communication the experiments are extended to the irradiation with roentgen rays.

Two guinea pigs were inoculated (Aug. 22) with 0.001 mg. bovine tubercle bacilli, Vallée strain, and then irradiated on Aug. 23 and 31 and Sept. 5 and 29 by using a technique in a previous communication (see above abstract). On Oct. 2 the guinea pigs were reinoculated with 0.1 mg. tubercle bacilli, same strain. The total number of leucocytes and the differential leucocytic formula were determined (from Aug. 22 to Oct. 14) and compared with the blood picture of 2 other guinea pigs inoculated at the same time and with the same dose but not irradiated.

The results of the experimentation were as follows. The irradiated animals showed immediately after the first irradiation a temporary increase in the number of the leucocytes which was followed later by a marked leucopenia (the total count falling from 12,300 to 4,700) and again by a pronounced leucocytosis as a result of the reinfection. Likewise the leucocytic formula showed initial increase of the polymorphonuclear cells with a slow but gradual decrease following further irradiations and a marked increase following reinfection. There was a marked diminution in the number of the eosinophiles and a complete disappearance of the basophiles. In the control animals there was an increase in the number of polymorphonuclears with practically no change in the rest of the blood picture. Thus the modifications observed in the tuberculous guinea pigs following irradiation were practically identical with those observed in normal guinea pigs following irradiation with the exception that the reinfection produced a more pronounced leucocytosis and especially polynucleosis than in the normal guinea pigs.

After comparison of the above modifications with those obtained following irradiation with ultraviolet rays the conclusion is reached that the two types of radiations, although they prevent a leucocytosis during the course of infection, have no or only little effect on the leucocytosis and polynucleosis produced by the reinfection.—*T. Leucutia.*

NEEFF, TH. C., and REISNER, A. Sabouraud doses in R-units. *Strablentberapie*, 1929, xxxii, 181–192.

Since the Sabouraud pastille still enjoys a large use in dosage in skin therapy, the author undertook to determine the Sabouraud doses in R-units.

Comparative measurements of the Sabouraud dose and the ionization dose in R-units confirmed the findings of other investigators in that there is a dependence of the Sabouraud dose on the different radiation qualities as expressed by the half-value layer. It was found, however, that the absolute full dose of the pastille shows considerable deviation from the number of R also with the same quality of radiation, in instances reaching a value as high as 30 per cent. This, in the authors' estimation is due chiefly to the variation in the color of the pastilles as well as of the comparing medium. The following recommendations are made: (1) One should never use for the comparison of the tint A of the fresh pastille a green tablet but a "zero test color" such as applied in Holzknecht's radiometer as "zero point." (2) The

color used for the comparison of tint B should not be of a different material. (3) A standardization of the reading methods of the color (lamp) should be introduced. The use of the Sabouraud pastille in the Holzknecht radiometer does not exactly comply with the requirement in (2) since the color scale often suffers with time a change in tone. Thus a comparison between the Sabouraud and the Holzknecht unit showed in the authors' measurements 10 × to be equal to 6.5 H, while Grebe and Bickenbach found it be to equal to 8.7 H, Hess to 4 H and Wucherpfennig to 5.5 H.

The conclusion is reached that an exact and reproducible dosage in skin therapy is possible only when the radiation quality is determined in half-value layer and when the doses are measured by the ionization method with standardized chambers independent of wave length and the sensitivity of which is known for the half-value layers of the whole range of radiation qualities used.—*T. Leucutia.*

PATERSON, R. S. Some factors influencing epiphyseal growth and union. *Proc. Roy. Soc. Med.*, March, 1929, xxii, 691–694.

A series of 1000 cases of normal adolescents was studied by Paterson, and the dates of appearance and fusion of the epiphyses were tabulated. There are often two ephiphyseal centers at the upper extremity of the humerus, separate centers for the head and the greater tuberosity. Overlapping of the shadow of the latter by that of the head makes it appear as a downgrowth from the head, and not as an actual separate center. Paterson concludes that in 50 per cent of cases a single center may be present for both the head and the greater tuberosity, while in the other 50 per cent two centers, one for the head and the other for the greater tuberosity, are found. He found a separate epiphyseal center for the external condyle of the humerus in 70 per cent of cases.

Factors affecting the dates of appearance and fusion are as follows;

1. Sex is of first importance in epiphyseal development which in the long bones is complete one to two years earlier in females than in males, except in the lower end of the humerus and the upper ends of the radius and ulna. In these bones development is complete four years in advance of the male.

2. Sexual glands play an important part. In all the cases of accelerated epiphyseal union which were observed, there was an associated sexual maturity, and such disturbances of the sexual or endocrine glands are considered the commonest causes of early union.

3. Any upset in the normal endocrine balance may profoundly affect ossification.

4. Excessive physical development and rapid growth in proportion to age, whether or not associated with mental precocity, are quite independent of epiphyseal growth, which remains unaffected.

5. Certain types of congenital dwarfism exhibit normal epiphyseal growth for their age.

6. Removal of one testicle does not affect epiphyseal growth, provided the other is normal.

In all the cases studied, pathological conditions affecting epiphyseal growth such as rickets, achondroplasia, scurvy, pseudo-coxalgia and diaphyseal aclasis were excluded.—*R. S. Bromer.*

PEMBERTON, R. Nature of arthritis. *Radiology*, March, 1929, xii, 235–238.

According to this author, a fifth of all cases of arthritis, especially those which are atrophic in type, show a slight decrease in metabolism. Metabolism of nitrogen, fats, calcium, phosphorus and uric acid seems normal, but there is a delayed removal of ingested glucose from the blood which closely parallels arthritis and focal infection. Coincident with this there is a delay in the utilization of oxygen, at least in the smaller vessels, due to a vasoconstriction, or a similar change, inducing a sort of anemia in certain structures. A study of the capillaries of the arthritic by Lombard's method of direct microscopic observation, shows that they contain on the whole less blood than normal, and that the stream tends to be sluggish and interrupted. These phenomena help to explain the beneficial effects of physiotherapeutic measures, notably exercise, massage and heat, all of which are widely used by the laity. Both exercise and external heat increase the circulatory rate, as shown by a sharp rise in the oxygen percentage saturation of the peripheral blood; they also induce an increase in the red cell count. The influence of massage in increasing the circulation is not so evident, but it does, nevertheless, have a very marked effect on the red cell count.—*J. D. Camp.*

PONZIO, MARIO. Ionometric measurements in inhomogeneous absorption media. *Strahlentherapie*, 1929, xxxii, 163–180.

After a detailed discussion of the factors pertaining to depth dose measurement, the author presents the results of his own investi-

gations proving that the practical values of the depth doses, as measured during the application of radiation therapy, are different from the theoretical values, as figured from the isodosis charts.

The author constructed homogeneous blocks of paraffin with air spaces scattered throughout the block. An ionization chamber (Solomon, Friedrich and Ponzio in rotation) was used to measure the influence of these air spaces on the depth doses. It was found that the deviation from the calculated values was especially marked when the air spaces were lateral to the ionization chamber. A further increase in this deviation was obtained when filling the air spaces with substances of different atomic weight (copper, zinc, silver, aluminum, calcium, potassium, etc.).

A similar inhomogeneity of the irradiated medium is often observed in the practical application of the radiation therapy over the different parts of the body as, for example, chest and abdomen. The changes produced by this inhomogeneity were determined by placing, in the case of irradiation over the abdomen, an ionization chamber in the vagina and by measuring the changes in the depth doses after filling the bladder and rectum with air and water. Often a variation as high as two-thirds from the theoretical value was obtained. It is evident that the administration of medications of higher atomic weight during the time of application of radiation must produce a further change of this deviation.—*T. Leucutia.*

RAJEWSKY, B. Standardization of technique of roentgen measurements. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 883–887.

In analyzing the introduction of the electrostatic unit as a unit of measurement of "roentgen dosis" and the terminology accepted by the Second International Congress of Radiology with regard to the definition of this unit the author criticizes the use of the term "roentgen dosis." Since a given radiation energy under various conditions may represent a different therapeutic "dosis" (the radiation effect depending on the distribution of the energy in a certain medium which in turn is dependent on the quality of rays, size of field, skin target distance, etc.), 1 R—a physically well defined amount of radiation energy—cannot express an absolute unit of roentgen radiation "dosis." The definition of a physical unit or roentgen radiation energy would correctly be: "The unit of the roentgen radiation energy (1 Roentgen) is that amount of radiation energy which by the irradiation of 1 c.c. air of 18°c. temperature and 760 mm. pressure, when the secondary electrons of the air are fully utilized and the wall effect of the ionization chamber is avoided, produces such a degree of conductivity of the air that the amount of electricity measured at saturation current represents 1 electrostatic unit."

The following physical values should be considered in the technique of roentgen measurements: (1) radiation energy—the total energy of radiation (erg); (2) total radiation current—the total energy which is radiated by a source in all directions per second (erg per second); (3) radiation intensity—the energy irradiating 1 cm.^{2} per second (erg per cm.^{2}); (4) total irradiation—the total energy irradiating 1 sq. cm. surface during a given time (erg per cm.^{2}).

The physical unit of the radiation energy can be expressed either in relation to intensity as proposed by Duane or to the total radiation energy as proposed by Villard, Friedrich and Behnken. It appears that Duane's method is the more practical.

The author then describes a new ionization chamber of small dimensions for the practical standardization in R units. The apparatus is controlled by radium. The following principles are established with regard to the practical standardization of small ionization chambers: (1) since the roentgen-ray beam is not homogeneous, the ionization chamber to be standardized should be placed in exactly the same position as the opening of the standard chamber. (2) Since the electrostatic unit refers to a given radiation energy and does not express the therapeutic effect of the radiation, the stray radiation originating from the tube should be eliminated by [illegible] application of diaphragms placed near the [illegible]e. (3) In order to prevent a variation in the radiation intensity due to changes of the focal spot during the running of the tube only perpendicular rays should be used for standardization. (4) In measurements at the margins of two media (air and water) the position of the ionization chamber should also be considered.—*T. Leucutia.*

RAJEWSKY, B. The question of roentgen dosimetry. *Strahlentherapie*, 1928, xxx, 555–566.

The author designed a new universal measuring instrument which is a modification of the well-known Dessauer-Winawer electroscope. The instrument is provided with a large ionization chamber as well as with a small spherical chamber which can be used as a standard chamber for practical measurements. The instrument is independent of the wave length, is very sensitive and is graduated in

R units. It can be used for the measurement of the quality as well as of the intensity of the radiation and for the depth doses of all types of rays from the hardest roentgen rays to the ultra-soft Bucky rays and the ultraviolet rays.

The instrument is provided with a specially constructed flat ionization chamber for the measurement of the back-scattering.—*T. Leucutia.*

Reinhard, M. C., and Tucker, K. L. Effect of *x*-radiation on crystalline and dissolved sucrose. *Radiology*, February, 1929, xii, 151–153.

The authors irradiated such organic crystals as hydroquinone, picric acid, resorcinol, quinone with very intense roentgen rays for long periods of time without producing a visible change. Sucrose (crystalline), however, became colored light brown after several hours of exposure; longer exposures produced a reddish-brown coloration. Experiments were done to determine the existence of invert sugar in the crystals of sucrose which were colored by the roentgen rays.

For this purpose, several grams of crystalline sucrose was sealed in glass tubes. These were wrapped in black paper to exclude any light, and were placed beneath a roentgen tube operated at 200 kv. and 30 ma. for various periods of time up to 107 hours. The exposure was not continuous, extending in actual time over several weeks.

Following the irradiation the sucrose was carefully weighed, dissolved in water, and the solution examined by the Kolthoff method for the presence of traces of invert sugar in sucrose. Control solutions of sucrose were also made up and examined in the same [illegible]. The controls failed to show any invert sugar.

The following conclusions are made: Roentgen rays color crystals of sucrose reddish-brown. These crystals when dissolved show measurable amounts of invert sugar. The production of invert sugar in sucrose solutions by roentgen rays is not satisfactory for dosage measurements because the amount formed with therapeutic doses is too minute for exact determination. The amount of invert sugar formed is not proportional to the concentration of sucrose but is proportional to the time of exposure. Roentgen rays have no effect on solutions of invert sugar indicating a secondary effect on the sucrose.—*J. D. Camp.*

Rosenthal, Josef. Thirty-one years of roentgenologic collaboration. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1928, xxxviii, 1035–1038.

Rosenthal gives a short review of the most important scientific and literary contributions of Hermann Rieder on the occasion of his seventieth anniversary. These contributions are: the influence of roentgen rays on bacteria; the reduction of time exposure in roentgenography; the flash exposures in roentgenography of the chest, heart and stomach; partial and total roentgenograms of the lungs, and in collaboration with K. Kaestle: roentgen cinematography of the internal organs, also called "bioroentgenography." A very important contribution was that of the cinematographic study of the stomach and especially of the digestive function. Finally, in collaboration with others, Rieder has edited a textbook on roentgenology in three volumes.—*T. Leucutia.*

Sokoloff, Boris. Does irradiation produce local immunization against carcinoma? *Ztschr. f. Krebsforsch.*, 1929, xxviii, 256–265.

The question of local immunity produced by irradiation was studied in mice by using the technique of Murphy and his coworkers. The experimental animals were shaved over both groins, then the animal was covered by lead rubber of 2 mm. thickness, a window of 1.5 × 1 cm. size having been cut opposite the left groin. Through this window the animal was irradiated by using the following factors; 30 kv., 22 ma., 27.5 cm. skin target distance, 5, 8 and 10 min. exposure without filter. Immediately following the irradiation, particles of a mouse adenocarcinoma Bashford, 63, were grafted intracutaneously in both groins. The size of the tumors was observed every ten days. The experiments included 70 mice.

Results. It was found that a local immunity similar to that observed by Murphy and his coworkers is produced by the irradiation. Seventy per cent of the grafts (10-minute irradiation) failed to take and the rest have developed considerably slower. Very small doses (5- and 8-minute irradiation) gave less satisfactory results.—*T. Leucutia.*

Swindells, Frank E. Some physical properties of fluorescent screens. *Radiology*, 1928, xi, 424–428.

An examination of the light emitted by a high quality fluoroscopic screen shows that most of this light lies in the region from 4300 Å. to 5400 Å. Thus it will be seen immediately that for the color region where the eye is most sensitive the fluoroscopic screen is most brilliant.

The determining factor in the speed of a screen is its ability to emit fluorescent light of the proper actinic power. The fluorescent light is, of course, proportional to the intensity of

the roentgen rays striking the screen, provided the quality of the rays does not vary. It is quite probable that a saturation value is reached similar to that found for phosphorescence, but this value is probably considerably beyond the limits of practical roentgenographic exposure.

The intensification factor, or the factor by which an exposure with screens must be multiplied to get an equivalent exposure without screens, is a function of several variables. It is to be expected that it will vary from screen to screen, dependent on the make of screen and the care exercised in its use. But it is not a constant for a given pair of screens, but is dependent upon the conditions under which the screens are used. It has been shown to vary widely with the hardness of the radiation, having its lowest value for the rays of greatest wave length, or soft roentgen rays. Thus at rather low voltages the intensification factor is much lower than at high voltages, where the beam contains a greater proportion of hard rays. Also where deep parts of the body are being roentgenographed, the composition of the beam of roentgen rays striking the cassette may be quite different from that of the original beam, and its effective wave length increased due to the presence of secondary radiation. The net result is that the intensification factor is appreciably less than if the original beam had been permitted to strike the cassette. The intensification factor should not be confused with the absolute amount of blackening or photographic density. It is, as previously stated, the ratio of the two exposures, one with screens, the other without, necessary to produce equal blackenings in the two roentgenograms, taken otherwise under identical conditions.

The intensification factor is not a constant throughout the range of densities on a single roentgenogram. It is least on the lightest parts of the roentgenogram, increases at the moderate densities, and falls off slightly when the densest parts of the roentgenogram are reached. The underlying cause for this variation is rather obscure.—*J. D. Camp.*

TAYLOR, LAURISTON S. The precise measurement of *x*-ray dosage. *Bureau of Standards J. Research*, April, 1929, ii, 771–785.

In 1927, Behnken, of the Physikalische Technischen Reichsanstalt, compared the *r* unit of several laboratories in Germany and that of Glasser and Duane. His measurements showed a difference of about 4 per cent between some of the laboratories. As a result of his attempted comparison with the Bureau of Standards, studies were undertaken to determine the error due to the use of different methods for measurement of the ionization current.

A kenetron rectified constant potential generator was used to supply the roentgen tube. The Duane parallel plate ionization chamber was used with several different electrical measuring systems in order to study the differences between each. It was found that only a null measuring method or the equivalent, such as a galvanometer, would yield accurate results. A simple deflection method or an idiostatic method distorts the field within the chamber in such a manner as to make the ionization current readings too high or too low depending upon conditions. The use of a galvanometer (Duane) does not disturb the field sufficiently to cause any error.

A slight displacement of the ionization chamber measuring and guard electrodes may introduce an error. This is more serious in a deflection method than in a null method. Ionization between the measuring electrode and case may affect the ionization readings in the idiostatic or deflection method but not in the null or galvanometer method.

The accuracy of the measurements can be carried out with a precision of 1.0 per cent or better, including the diaphragm error.

A full description of the *constant potential generator* is given. There is also a full description and discussion of the null electrostatic measuring method.—*Author's abstract.*

WEATHERWAX, J. L., and WIDMANN, B. P. Physical factors in radiation therapy and their clinical application. *Radiology*, April, xii, 297–308.

Systematic records of all radiation treatments are of paramount importance in order that end-results may be compared and various techniques given proper evaluation.

The graphic chart illustrates all of the conditions of treatment, such as: (1) total intensity in the tumor area; (2) total intensity on the skin; (3) saturation value in the tumor area, and (4) saturation on the skin. These lines are plotted so that they can be read in terms of percentage of an erythema skin dose or in terms of milliampere-minutes.

Cross-section charts and depth dose charts aid one to visualize quickly the direction of the rays, so that depth intensity can be regulated with almost exact precision. The number of fields will be controlled by the desired dose effect.

Progress and efficiency in radiation therapy entail meticulous application to the details of the underlying physical principles, and a systematic adaptation of accurate records to properly evaluate clinical results.—*J. D. Camp.*

Wood, F. C. Cancer biology and radiation. *Radiology*, 1928, xi, 388–392.

Anaerobic glycolysis is not a characteristic of the tumor cell nor does it explain why the normal cell becomes a tumor cell, though Warburg has revived the old hypothesis (see, for example, Wyss, *Münchcn. med. Wchnschr.*, 1907, liv, 1576) that when normal cells are subjected for a long time to partial oxygen starvation they may in some way adapt their metabolism from the oxidation type to the lactic acid type and thus become cancer cells.

The stimulation of tumor growth by the administration of glucose has been tried by several Austrian radiologists, who believe that by stimulating the tumor to increased activity better effects are obtained from radiation. They overlooked the possibility that metastases out of range of radiation might also be stimulated. But Prime was unable to demonstrate this in animal tumors. No effect should really be expected, for the blood of most diabetics contains a large excess of free glucose and no excessive virulence or growth-rapidity is found in cancer arising in the course of that disease.

Gye's demonstration of what he supposed to be a combination of a virus and a chemical adjuvant, the combination of which produced tumors, has not been reproducible in other laboratories, and the demonstrations by Carrel and others that filterable tumors could be obtained in the fowl by tar and other reagents has rendered the presence of a living virus questionable.

The report of Sittenfield on positive results of such transmission by filtration, points only to the necessity of extremely careful technique, for his statements have not been confirmed by others, and the fact that fragments of tumor cells can get through the pores of filters highly impermeable to bacteria renders it possible that all positive results hitherto obtained have been due to the escape of viable cell particles of minute size rather than a demonstration of the presence of a true filterable virus.

The morphological changes which accompany the destruction of tumor cells by roentgen rays and gamma rays have been shown by Wood and others not to be characteristic of these radiations, but an effect common with other physical agents, such as heat and cold, on the cell. Chemicals and ultraviolet light have been shown to have similar effects upon the nuclei of the cells. It is, therefore, probable that any physical agent, within limits, will cause the same sort of chromosomal changes as the limited region of radiation comprised in roentgen and radium radiation.

The ease of reading and cheapness of the *Drosophila* material has rendered possible not only the standardization of roentgen machines for clinical uses, but has confirmed with surprising ease many of the laboriously obtained facts concerning radiation. The increase in surface dose from back-scattering with large portals and short wave length roentgen rays, depth dosage with different portals and wave lengths, etc., all are easily demonstrable. The material is very constant and obtainable in every part of the world. The technique of manipulation is easy, and the results can be read in forty-eight hours, so that it is to be hoped that larger use may be made of this very simple means of estimating biological dosage.

As we approach a complete knowledge of the physical aspects of radiation and the technique becomes more and more perfect, we are faced with problems still more difficult than any previous one. These are, how to apply a sufficient dosage without damaging the patient and yet kill the tumor, and also how to tell which tumor will yield to radiation and which will not. Some insight into these questions must be given before radiotherapy becomes a scientific method.—*J. D. Camp.*

Rohrschneider, Wilhelm. Experimental investigations on the changes of normal eye tissues following roentgen irradiation. II. Principles of irradiation effect; changes of the conjunctiva, cornea and uvea following roentgen irradiation. *Arch. f. Opbth.*, Feb. 4, 1929, cxxi, 537–559.

After a brief discussion of the general principles of radiation effect, the author determined in a second series of experiments the effect of the roentgen rays on (1) conjunctiva; (2) cornea, and (3) uvea of rabbits.

(1) Conjunctiva. By applying hard rays of 0.5 mm. Cu and 3 mm. Al, a selective action on the cells showing the highest radiosensitivity is observed with 890 R (100 per cent epilation dose, equaling 180 per cent human S.U.D.) and a more pronounced action with 1340 R (150 per cent epilation dose, equaling 270 per cent human S.U.D.). From 1770 R (200 per cent epilation dose, equaling 360 human S.U.D.) up there is appearance of irreversible injuries resulting in obliteration of the conjunctival sac. By applying soft roentgen rays (3 mm. Al) changes occur already with 612 R, and with 980 R (100 per cent epilation dose, equaling 230 per cent human S.U.D.) they are very severe.

(2) Cornea. The first microscopic signs of roentgen injury on the epithelium of the cornea are observed (within thirty days) with a dose of 1340 R by hard rays and 980 R by soft rays.

The dose leading to irreversible injuries is 1770 R (360 per cent human S.U.D.) for the hard rays and 1470 R (255 per cent human S.U.D.) for the soft rays.

(3) Uvea. No changes were observed on the iris, ciliary bodies and choroid (except for an early erythema) since doses which would be large enough to produce a deleterious effect on these tissues would in the first instance produce a marked injury to the cornea.—*T. Leucutia.*

SCHMITZ, W., and RIENHOFF, O. Measurements with the sphere gap. *Strablentherapie*, 1929, xxxii, 582–588.

The authors undertook a number of measurements with the sphere gap on different types of electrical currents in order to determine the effect of the insertion of various resistances (water resistances) into the line.

The following conclusions were reached: The amount of resistance is without influence on the sphere gap in a continuous current; in alternating current, however, an error is committed which can be corrected.

In pulsating continuous current the measurement is accurate if the resistance is not all too great (maximum 30 megohms). High peak tension curves (inductor) should not be measured by sphere gaps.—*T. Leucutia.*

SIEGERT. The behavior of the uterus-stimulative substance of the hypophysis of the guinea pig following castration and roentgen irradiation of the ovaries. *Klin. Wchnschr.*, May 21, 1929, viii, 979–980.

The effect of the hormone of the posterior lobe of the pituitary gland on the musculature of the uterus is well known. The variation of this effect is in direct dependence on the activity of the genital glands. The author undertook numerous experiments to determine this dependence.

In a first series (29 animals) the genital glands were surgically removed. In a second series (20 animals) the ovaries were destroyed by roentgen rays, and a third series (22 animals) were used as controls. Only virginal animals of 250 to 300 gm. weight were employed. The surgically castrated animals were killed within twenty to fifty days or fifty to one hundred days following the castration, the irradiated animals thirty to fifty and fifty to seventy days following the irradiation and the control animals both in diestrus and estrus. Immediately following the killing the pituitary glands were desiccated (by acetone, calcium chloride and phosphorus pentoxide in turn), pulverized and sealed in glass tubes.

For each experimental application a fresh preparation of the extract was made (the ratio being 1 c.c. extract to 5 mg. desiccated hypophysis) and used for the stimulation of isolated uteri of rats and guinea pigs (in Thyrode's solution at a steady temperature of 37°C.).

The following conclusions were reached: (1) The hypophysis of the surgically castrated animals acts considerably slower on the uterus than the hypophysis of normal animals. (2) The hypophysis of roentgenologically castrated animals produces during a period of the first fifty days following the roentgen irradiation an increased stimulation of the uterus, while from the seventieth day on the effect is the same as in normal animals. (3) There is no difference in the action of the hypophysis in the animals during estrus and diestrus. (4) The effect of the hormone of the posterior lobe of the hypophysis on the genital apparatus is through the vegetative centers of the midbrain.—*T. Leucutia.*

SULKOWITCH, HIRSH W. The bactericidal action of roentgen rays. *Johns Hopkins Hosp. Bull.*, June, 1929, xliv, 439–442.

The author performed a series of experiments for the study of the bactericidal action of roentgen rays on *E. coli*, *Staphylococcus aureus*, *B. prodigiosus*, *B. pyocyaneus* and *Sarcina lutea*. A roentgen-ray diffraction apparatus equipped with a Coolidge water cooled molybdenum target was used and the tube was operated at an effective voltage of 35,000 to 40,000 and a current of 20 ma. A circular alloy casing which surrounded the roentgen-ray tube contained 15 apertures for the attachment of diffraction cassettes. The microscopic slides containing the above-mentioned bacilli on different nutrient media were placed in these cassettes at a distance of 17.5 cm. from the target, and irradiated. Following the irradiation the standard cultures were examined as to their virulence.

It was found that roentgen rays are lethal to bacteria if given in a sufficiently large dose and that different bacteria show varying degrees of susceptibility.—*T. Leucutia.*